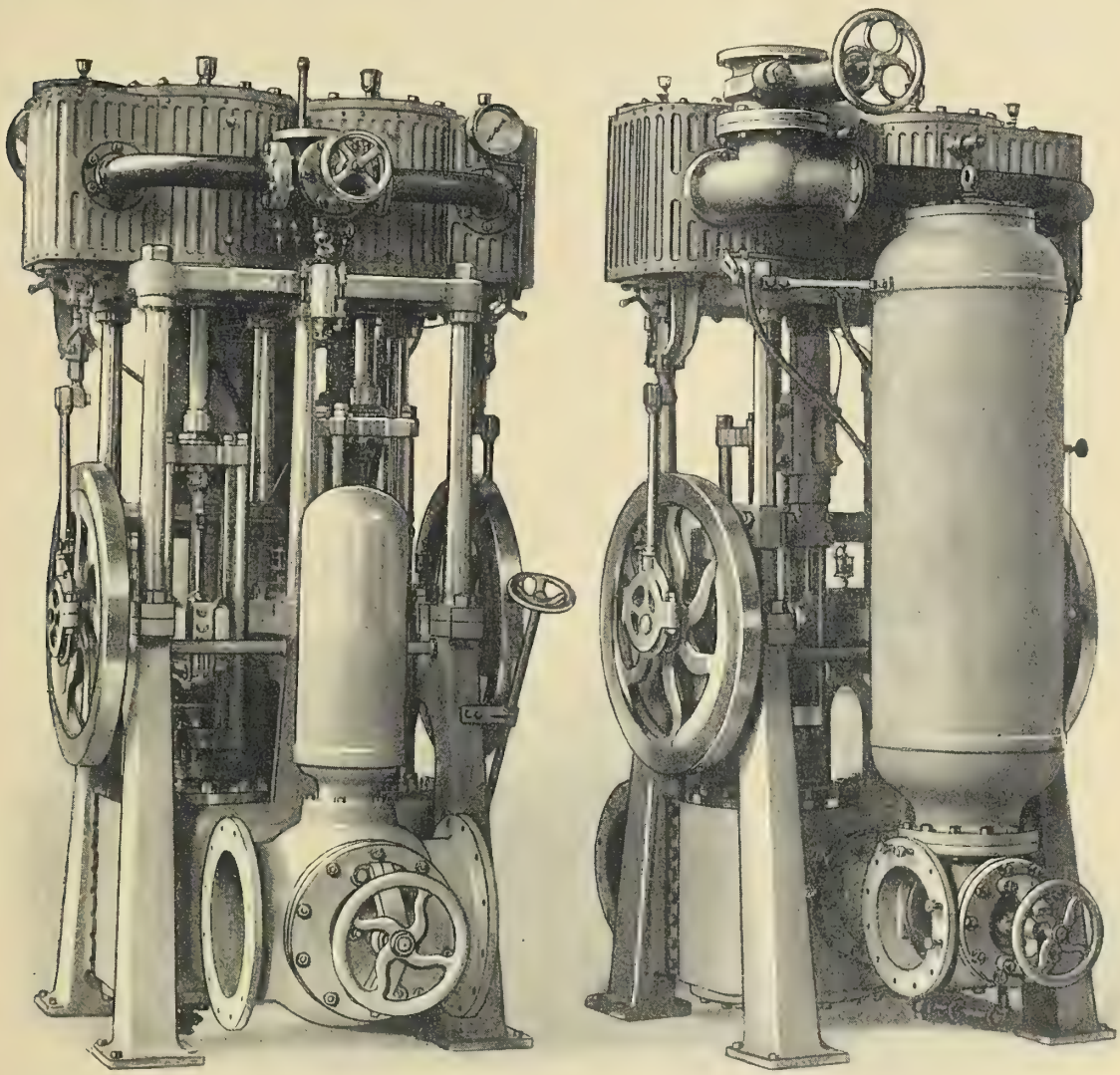
MARINE ENGINEERING.

Vol. 2. NEW YORK, JULY, 1898. No. 7.

FIRE BOAT ROBERT A. VAN WYCK FOR THE CITY OF NEW YORK.

The City of New York has recently added to its fleet of fire boats a new vessel called the "Robert A. Van Wyck." This boat was built from designs made by H. de B. Parsons, a consulting engineer of 22 William street, New York, and the contract was awarded to John H. Dialogue & Son, of Camden, N. J. This contract included the boat complete with the exception of the fire pumps, which were furnished by the department, and were made by the American Fire Engine Company, of Seneca Falls, N. Y., in accordance with specifications drawn by Mr. Parsons.



DUPLEX CRANK AND FLY WHEEL FIRE PUMPS FOR FIRE BOAT ROBERT A. VAN WYCK.

The boat is 110 ft. 6 in. over all; 102 ft. on water line; 24 ft. beam, and draws 9 ft. of water.

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The block co-efficient is 0.539; the prismatic co-efficient 0.658, and the displacement tonnage is 306.8. As will be seen from these figures, the lines of the vessel are very full, which was necessitated by the great weight to be carried under the restrictions of length and draught.

Steel was used entirely throughout the construction; and full sea-going weights were adopted for all parts, although the boat is restricted for harbor use. This was done for the purpose of giving additional strength in order to withstand the hard usage of the service, which requires the boat to be continually running in and out among slips and docks. Practically the only wood used was in the construction of the decks, and these decks are protected by a sprinkling system.

The general scheme of design can be seen in the section published herewith: There is a steel deck house, the forward end of which is elevated for the purpose of giving the pilot an extended view in all directions. At the after end the deck house is lowered in the form of a trunk cabin, in order that fire streams may be thrown across the boat in case of emergency.

With the exception of the windows in the pilot house, all openings are made with large port holes, most of them being 18 in. dia. The object of this was to protect the boat in case of a misdirected fire stream from some other boat or tug.

The pilot house is finished in cherry, and contains both the hand and steam steering wheels, which are so arranged as to permit the pilot to change from one system to the other within a few seconds. The two steering systems are controlled by means of a friction clutch which is operated by a hand wheel in the floor of the pilot house. Directly beneath the pilot house is a Manton steam steering engine, and so arranged as to be accessible at all times for inspection or cleaning. The pilot house is equipped with the telephone and fire-gong signaling system, connected to the shore end by means of a flexible cable which can be quickly connected or disconnected.

Abaft the pilot house and connecting with it is the captain's cabin. This room is made large, and is intended to be used as the office of the fire station, and contains a desk and berth. Abaft of the cabin is the fire room hatch. Abaft of the hatch is a store room for the play pipes and nozzles, all of which have their proper places upon shelves so arranged as to make them convenient for the men when the boat is called for fire duty.

The after end of the deck house contains a large living room for the crew, fitted up with berths and sofas, and a folding table. This room overlooks the engine room hatch, so that the captain could be stationed in this room, and while having a complete view of the operation of the boat could still be close to the engineers for the prompt transmission of orders. The forecastle is fitted up as additional sleeping quarters for the crew, and contains a bath tub, wash basins and other conveniences. At the after end of the boat there are two state rooms which will be probably used by the engineers, as they open into the engine room. With the exception of these state rooms and the forecastle, the rest of the boat is utilized for the machinery.

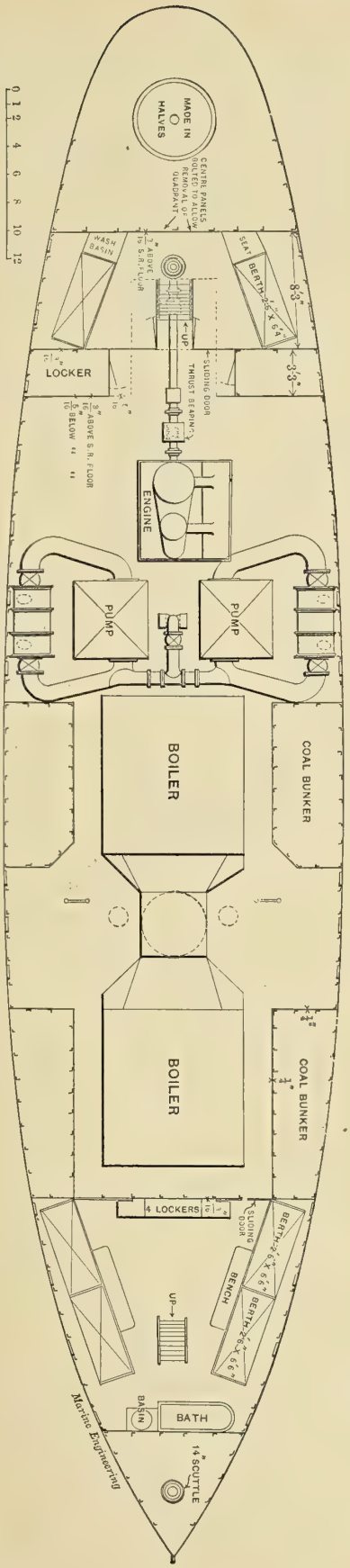
Steam is furnished by two Scotch boilers each 10 ft. 1 3-8 in. dia. and 11 ft. 0 1-2 in. long, fitted with two Morison suspension furnaces. They are designed for a working pressure of 135 lbs. Each boiler has 132 3 in. tubes and contains 77 sq. ft. grate surface and 2,100 sq. ft. of heating surface.

The fire room is purposely made very large, in order that it may be as cool as possible during the summer months, and receives light through the engine room hatch above and through three port lights on each side. On each side of the boilers are the coal bunkers, which are designed to carry from 25 to 30 tons of coal. The bunker bulkheads are set away from the boilers, so as to leave a passage on either side, and, in fact, there is no part of the boilers which cannot be reached with convenience and ease.

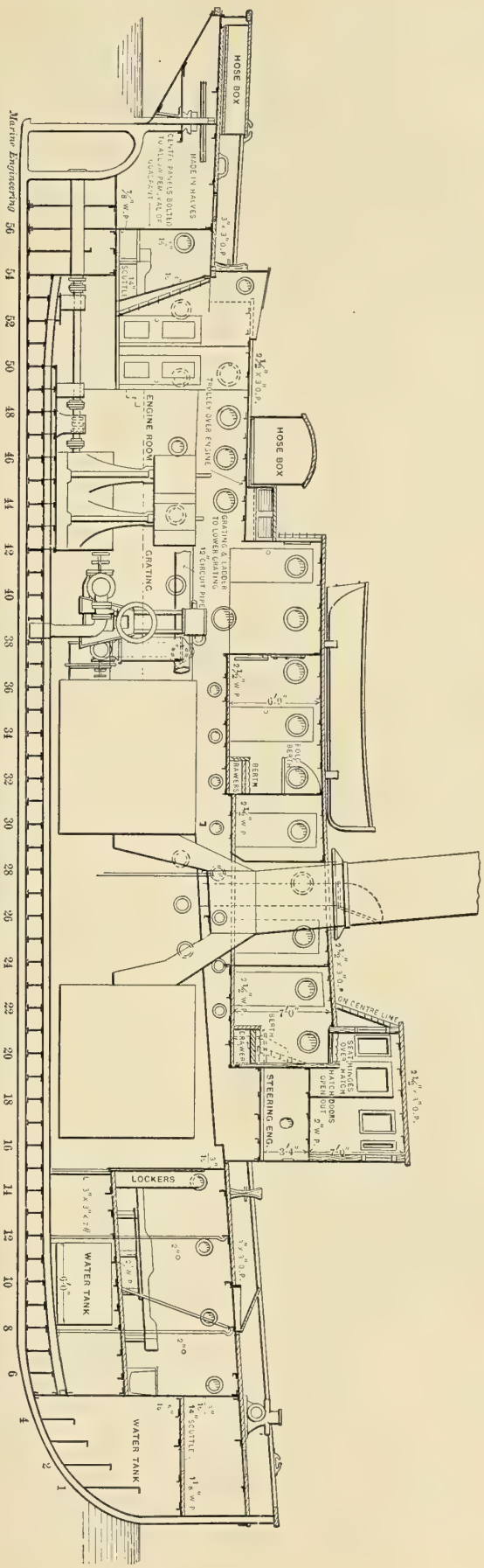
The boat is propelled by a fore and aft compound engine having cylinders 16 in. and 30 in. dia. by 22 in. stroke. The high pressure cylinder is furnished with a piston valve, and the lower pressure with a double-ported slide valve. The piston rods are extended so as to form tail rods, and all the glands of both piston rods and valve rods are packed with metallic packing. The propeller is 7 ft. dia. and has an average pitch of 10.59 ft. The rudder was made very large, and in consequence the boat responds very quickly to the helm.

The fire pumps are arranged across the boat athwartships, and are placed between the after boiler and the main engine. Each pump is of the general standard type as built by the American Fire Engine Company, and are of the duplex, crank and fly-wheel type. The steam cylinders are 17 in. dia., the water cylinders 10 in., and the common stroke is 11 in. The suction mains are 16 in. dia., and are connected to large suction bays on each side of the vessel. The area through the strainers, as well as through the valves, is made purposely large, and in consequence the pumps run extremely quiet. The piping is so arranged that each pump can draw from either side at will, or the pumps may be used to pump out the bilge in case of accident to the vessel. The discharge from the fire pumps lead into a large copper circuit pipe which extends all around the deck house; and at the forward and after end are placed twelve hose connection valves, which range from 3 1-2 in. dia. to 6 in. dia., and all are equipped with the New York standard thread. Besides the hose connections there are three monitor nozzles—one large one on the forward deck, one on the top of the pilot house, and one on the after trunk deck.

PLANS OF THE FIRE BOAT ROBERT A. VAN WYCK, BUILT FOR THE CITY OF NEW YORK BY JOHN H. DIALOGUE & SON, CAMDEN, N. J.



LOWER DECK PLAN.



INBOARD ELEVATION.

This arrangement will permit streams from these nozzles to be operated no matter in what position the boat may be placed.

The trial trip was made in the Delaware river, and the boat ran from the yard of the builders at Camden as far as Wilmington and back, and the average speed for the run was nearly 13 miles per hour. The fire pumps on trial discharged over 3,400 gallons per minute each, while working against a water pressure of about 180 pounds; probably the finest set of pumps ever furnished to a fire boat.

In working up the design every care was taken in order to make the boat simple, serviceable and readily handled in cases of emergency. The general arrangement is such that one man can easily operate the main engine and both fire pumps, all the necessary valves and levers being placed near together and close to the engineer's position on the starting platform.

MARINE ENGINE REPAIRS DISCUSSED IN A THOROUGHLY PRACTICAL WAY.*

BY J. KYLES, M.E.

In introducing his subject, the author spoke of the tendency to do work hastily nowadays, which made it specially necessary that a strict watch be kept to exclude unsound material or bad workmanship. The effort of engineers should be to produce lasting work.

Repairs to Cylinders.

Cylinders occasionally require boring out. A good job can be made in their place with a boring bar; this is a somewhat expensive tool to make, and should be as stout as is practicable. There should be about 1 in. of space between the sliding block and the cylinder, and to obtain the truest result have the bar revolving in a journal attached to a strong bracket well bolted across the mouth of the cylinder, the other end in the neck bush resting on a steel center which can be bolted on the stuffing box studs. It sometimes happens that a boring bar will chatter when the tools commence to cut, chiefly owing either to bad fitting journals or the cutters not being properly ground. Every cutter ought to have an equal share of work to perform, and I should say, to make a good job, the boring bar should not be allowed to stop while the finishing cut is being taken. The cylinder having been bored, what is to be done with the piston, which is now too small? Some would say, have a new one. But a new one is not necessary, as by shrinking on a good iron or mild steel hoop 5-8 in. thick with 1-8 in. V groove to prevent its coming off; this hooped piston ought to be turned 1-32 in. smaller than a cast iron one; this method of repairing a piston has been found to work very well. I do not intend going into the many designs of packing rings in use; but the ones that are in greatest demand at present are the "Ramsbottom," which consists of a floating ring in halves with three spring rings. The larger the cylinder the greater natural spring must be given them, also the usual overlap to prevent steam from passing, "cod" pieces not being required. To make these spring rings round, they should be finished in the lathe after being cut, thus insuring a perfect fit in the cylinder. Often cylinder liners have to be renewed, owing to softness of the metal or other causes. These should be cast with about 8 in. of metal head to allow for any bad or dirty metal, thus insuring a much sounder casting. There are different methods of fixing cylinder liners; one is to have a flange on the bottom of the liner and have the same scraped up as valve faces used to be, viz., perfectly steam tight, then bolted to the bottom of the cylinder, and the top of the liner caulked either with copper or lead to make it steam tight. Another is to have the liner turned a tight fit to the cylinder and screwed tight down with bolts into its place.

Crank Shaft Construction.

The new system of securing built cranks by bolting the web to the shaft does not seem to be so secure as by shrinking the webs on. I have seen them in the repairing shop having the holes reamed out and a new set of bolts fitted. This shaft has a great tendency to get out of truth when the bolts become loose; in one case 3-32 in. had to be turned off the shaft to get it true. There is another style of built cranks, the webs of which often get loose, viz., those with collars and eccentric ends. These cranks look very neat when completed, but they do not last so long as those where the part that is shrunk into the web is the same size as the crank pin. When the pin of a built crank shaft is broken the best way to remove it is to build a mould around the web and pour hot metal into the mould; at the same time be ready with an "hydraulic" jack to press it out, as soon as the web is sufficiently expanded. Heavy crank pins require great pressure to start them; it took 160 tons' pressure to start the steamship Belgic's crank pin. It is not a difficult matter to shrink on webs and pins in a new crank shaft, as the journals are all turned up true in the lathe after it has been put together, but in putting a new crank pin into an old shaft great care is required, so that both journals may run true. A good method is to bolt the coupling end of the shaft on the face plate, of a large lathe, keeping the "eye" that is to be shrunk perfectly level; strap the pin, which is now finished, on to the carriage of the lathe, keeping it level and square with the web; make a gauge from the center of the shaft to the crank pin eye. This is to ascertain the amount of expansion that takes place in length and height. Now apply the Lucigen light, which is much quicker than either charcoal or wood, and when the eye has expanded sufficiently to receive the pin, run up the carriage and the pin, insert it the required distance and cool gently by water; next proceed to get the other

*From a paper read by J. Kyles, M.E., before the Institute of Engineers and Shipbuilders of Hong Kong.

end of the shaft on the carriage of the lathe, great care being taken to get it true in every respect, always allowing for the change of form the gauge showed when the web was hot, which in the case cited was at full 1-16 in.; then apply the lamp as before, and in about two hours you can run the other part of the shaft into place, taking care to ease all bolts to allow for contraction, which will now, of course, take place on the web last heated. When the crank is cold it will be found to be true and ready for bedding in place. When a spare shaft has to be put in, the coupling bolt holes are generally found 1-4 in. small to allow for cleaning up and fitting. It will be found to be much the quicker way to take it to a machine (if handy) and get the holes bored out than doing the same with manual labor on board. Coupling bolts are made by some engine builders parallel and by others taper, with and without heads; those without heads should be made with much more taper than those having heads. Sometimes the taper bolts become loose, owing to their having, in some cases, 1-4 in. to the foot taper; this, I consider, is far too little. Where there is no head on the bolt, 1-2 in. to the foot should be given; the parallel bolt with head is easy to fit, but when they require to be renewed after running a few years, the thread, and often the ends, get completely spoiled in taking them out; this means new ends, and frequently they require to be drilled out.

Main Bearing Brasses.

Why do so many main bearing brasses require lining up on the sides? Is it because they have been badly fitted? Possibly so, but the principal reason is they are machined on the sides and fitted in their places and then bored out, and when taken adrift are found to be rather easy, and in a few years the constant strain on the shaft necessitates a liner being put on. A heavy main bearing brass ought to have the skin broken all over before being fitted, as an alteration of form takes place owing to its tension.

Piston Rods.

In many piston rods too little shoulder is left where the piston butts on the rod; the result is that when the rods require turning up there is no shoulder left for the piston to rest on, and the result is a new end must be welded on the rod, or the present small shoulder left on, which means the gland and neck bushes in halves. To prevent scouring the rod, the bushes must be cut at an angle or checked. Some engine builders make their rods of hard steel to withstand wear and tear, but when a new end is required on these rods they cannot be welded with certainty; this often means a new rod, and becomes a very expensive repair, unless the new process of welding hard steel becomes successful. This is now under trial.

Valve Faces.

Valve faces often require renewing, and the time one is often expected to finish this important piece of work in is often insufficient to insure good and sound workmanship. After the valve face has been moulded, it must be thoroughly dried in the stove. Certainly a valve face can be moulded and cast the same day in green sand, but it cannot be depended on. A good plan is to cast the valve face solid and cut the ports out with the machine; this ensures a sound casting with no risk of flaws or cracks, which often occur when contraction takes place, done in the ordinary way. In machining valve faces a finishing cut should always be taken after the ports are cut out, so as to insure a dead true surface. Should valves at any time require piecing on either steam or exhaust edges, and brass is used, which is often done, a bare 1-32 in. should be allowed below the face for difference of expansion of the metals.

Piston Valves

There is a great diversity of opinion as to the merits of the solid or adjustable piston valves. For my own part, I consider that the solid piston valve with three water grooves works very well for the smaller class of engines, say up to 12 in. valves, but in the larger engines, where it is possible to get at the adjustments of same, it is very convenient to have them split. Experience has demonstrated that cast iron piston rings will wear smoother and better surrounded by steam than any other metal. Many engine builders overlook the fact that sufficient clearance is not left in the valve chambers at the piston stroke, the result being that after working for some time ridges occur and have to be removed by chipping or otherwise, which in confined places becomes difficult and expensive.

Eccentric Straps.

We often find in the workshop that the top eccentric strap liner requires to be renewed, while the under liner is very little worn. Now, if both top and bottom straps were made alike, to suit the foot of the eccentric rods, the bottom could be brought to the top, and vice versa, thereby getting double the life out of them. Should white metal be introduced instead of the brass liner, the eccentric sheaves should at all times be turned true and smooth, for unless white metal has a true and smooth surface to run on at the beginning, it will not give satisfactory results. This rule applies to all moving parts of the engine where white metal is used. Metallic packing is also at times applied to piston rods and valve spindles after they have been cut up with other packing, under the impression that the rods will again become smooth. This is a great mistake; no patent packing will give satisfactory results unless the rod is working true and smooth.

Feed and Bilge Pump Plungers.

These often give way at the stems, especially those with cotters through them. A screwed stem is much preferable to one with a cotter, but care should be taken to have a radius at the neck to insure strength. A good method of securing the stem is to carry it the whole length of the

plunger, and have it screwed in the bottom of the plunger with a jam nut outside. I have seen plungers, after being turned up and the glands rebushed, get very badly scored in a very short time, owing to their being carelessly packed with common packing, and the same being screwed up much too tight. A little thought and attention to these details would insure a longer life to many pump plungers. Cast iron bilge pump valve chests are often so badly fitted that a new brass seat as originally made is impossible, there being no bearing to keep it in its place. When such is the case, the only plan is to renew it, to make a proper job. Occasionally time will not permit of a new one being made; then the quickest way out of this difficulty is to have the suction and delivery seat cast in brass, all in one piece, with ports cut out at the sides. This seat can be held in its place by the cover resting on the top of the seat.

Miter, Fiber and Check Valves.

Miter Valves should be a thing of the past, as they are always making the seats larger and cannot be kept tight for any length of time. Flat valves and seats are much easier scraped up and will keep tight much longer. A great amount of labor is caused in breaking joints and removing valve chests and sending them to the engine shops to be refaced.

Fiber valves have a great tendency to become oval when doing their work in the air pump, thus robbing them of their efficiency. To overcome this trouble, a good way is to put them in hot water for two or three days, and then put them in the lathe and turn them while hot, and although they may alter a little when dry, they will become quite flat and true when doing their work in the air pump.

Check valves should always be made of the best gun metal, as anything going wrong with this important chest means detention, and serious consequences may follow.

Crank Pins and Brasses.

Crank pin brasses often require remetaling with white metal. When made of brass they should always have the recess for receiving the white metal thoroughly tinned, so that the metal will adhere to the back of the bushes, and not altogether depend on the dovetailing. Crank pin brasses often become cracked fore and aft. I have known them to run a long time, and very well, with a mild steel liner pinned on the back. Some advocate burning them together, but my experience does not induce me to advocate burning anything that has much work to do. A steamer on this coast went over a bed of sand, with the result that sand was drawn through the condenser, filling up all the tubes; the consequence was the pump levers were bent, circulating pump chest broken, etc., which caused a very heavy repairing bill. Steamers that trade anywhere in the vicinity of "sand banks" would do well, I think, to have top and bottom injection valves fitted. I know of a case where this was fitted, and in going into harbor the ship touched the bottom, thereby stopping up the "rose plate" of the bottom injection. The engineers soon discovered that no water was passing through the condenser. The top injection was now opened, when the engines at once got away all right, showing the utility of the two injection valves. At Tientsin and Shanghai steamers are fitted so. All pins fitted into double jaws ought to be stepped. Often they have to be renewed because they are parallel, the wear taking place in the center where the motion is, which reduces the diameter; but in stepped pins, even although the working part requires turning up, it can be done without interfering with the fitted part. This overlook is also seen in other parts of the engine when repairing same; for instance, some of our coast steamers have worm wheels fitted on their reversing gears, the bore being the same size as the journal and screw. To repair these, an iron liner in two halves must be pinned on the shaft and the worm wheels bored out (larger) to suit.

Copper Piping.

A very important matter in marine engine work is the repairing of copper steam pipes. In small pipes from 4 in. dia. down to 1 in. the coppersmith has little trouble. His principal care is to see that all bends are perfectly round and corresponding in bore to the straight part of the pipe. Resin is mostly used for filling copper pipes which require bending. The great drawback to resin in this climate is the difficulty to get it sufficiently cold, when inside the pipe, to insure good bending; thus, if a copper pipe filled with resin is not thoroughly cold it is impossible to make a good bend. But allowing that a copper pipe has been previously softened by making hot in a coke fire and cooled by the atmosphere gradually, then filled with resin and kept under water all night, in the morning you will find the resin crisp and strong. When the coppersmith bends the pipe you can hear the resin cracking, similar to the noise made when you break a stick. If a job is urgent, lead is resorted to. The copper pipe is first softened, then filled with molten lead and bent. The only good quality lead has for pipe bending is that you can cool it so much quicker than resin. A pipe that would take nine hours to cool with resin can be cool with lead in one hour and ready for bending. If time was no consideration, lead would never be resorted to, because there are so many accidents incidental to the use of lead. For instance, we take a copper pipe 3 in. dia. which has been filled with lead and bent; you will find the bent part of the pipe smaller in bore to the other parts, showing that the lead has got smaller or drawn out when the pipe was bent. Another danger is the propensity lead has to corrode copper when both metals are in contact in a heated state. Great care has to be exercised in melting the lead out of the pipes; the heat has to be regularly

applied along the pipe. If, through carelessness, the pipe gets red hot and melted lead left lying on the hot inner surface of the pipe, it will corrode the copper, and if continued any length of time it will burn a hole through the pipe. This is the frequent cause of pipes having holes through them. Often copper pipes are found strong throughout, but one part very thin, which possibly has been caused through the action of the lead on the hot copper when the pipe was being made. Now, with resin we have none of those accidents. It can be formed in a liquid much easier than lead. Resin expands in bending, keeping the copper the full size at the bends. If time would allow it, all copper pipes should be filled with resin for bending. Solid drawn copper pipes may have many flaws not noticeable to the naked eye. Often the hydraulic test reveals weaknesses and flaws which otherwise we would be unable to determine until the steam was put on the pipes. With brazed pipes it is quite different. They are made by hand, and are cut from the flat sheet of copper, and any flaw can be detected before the coppersmith has rollled the pipe together preparatory to brazing the seam. The seams of all copper pipes should be the strongest part of the pipe if they have the proper overlap and the brazing well done; but, by insufficiency of lap or scarcity of solder, the seams often show signs of weakness. Then pipes are not to be depended on, and the first part to give trouble would be the defective seam. The spigot flange is much the stronger and more serviceable flange, and in brazing flanges a gradual heat is required, being greatest at the fluxing point. To insure a strong brazed flange it is necessary to have the flange and pipe at the same temperature, so that when the solder melts it has an equal attraction from all sides. Some engineers think by giving an order for a spigot 6 in. long they are getting a stronger job. They are mistaken. The brazing only makes a thorough strong job for 2 in. of length, and is stronger than the pipe itself. Copper tee pieces are best made from sheet copper, and the flange part carefully worked over hot and cold alternately. The inside copper tee piece is the strongest; this tee piece is brazed from the inside, making a strong joint between pipe and tee piece. With saddle tee pieces often only the edges are brazed. This makes a weak job. Of course, there are pipes on which, from the construction of their bends, it would be impossible to braze an inside tee piece, but wherever practicable a tee piece brazed on the inside is much stronger than one brazed on the outside.

On Propellers and Shafting.

Should the bore of propellers on the large end be found pitted, either by being neglected or by lying in the hold as spare gear, or to have been badly fitted on the shaft originally (many establishments are far too careless in the fitting of this important item), a good job can be made of it by boring out the pitted part of the propeller and carefully fitting in a steel liner, say 3-8 in. thick, having a recess bored out for a collar, which must be large enough so that the key seat will not cut it through, and pinning the liner with countersink pins. Should it be the small end of the propeller boss, leave a shoulder for the liner to rest on, which will take the strain off the pins when the propeller is being driven on the shaft and being fitted. Cast iron and steel propellers are all liable to extensive pitting on the back of the blades. Tin has been tried as a remedy for this, also many other devices, but the best I have seen for preventing this pitting and the wasting away of the blades in this particular spot is the fitting on of a brass liner, say 3-16 in. thick on the blade tips, riveted to a narrow strip of brass, say 4 in. broad on the go-ahead side, which fastens the edge of the brass liner, the remainder being secured to blades by stud rivets. This I have always found to give satisfaction. All right-handed propellers should have left-handed screws on the shaft. By doing this the nut would have a tendency to tighten itself on the propeller, and vice versa for a left-hand propeller. Should the brass liner on the shaft get loose, I may mention three methods of putting it on, viz., by hydraulic pressure, shrinking and casting. Few establishments make use of the hydraulic plan, owing to the varied lengths of shafting. The casting on of the liners is not much in vogue, owing to the tendency of the heated shaft to bend. The most popular method of putting on liners is by shrinking them on, proper allowance being made for tightening on the shaft; and, if properly done, there is not much fear of their coming loose, pins being used to assist in securing them. I have seen a liner quite tight to the two ends and condemned for being loose in the center, caused, I should say, by being allowed to become hot. In forging a new end on a propeller shaft in the furnace the first process is to cut off the bad end of the shaft, stave up the end to allow for deterioration by the heat, then procced to lay on the shingled iron which is made from scrap, working it under the steam hammer until the proper size and length is attained. In this way the shaft is equally as good as new. Large piston rods ought to be dealt with in the same manner when a new end is wanted. The fracture of propeller shafts very often occurs at the ends of the brass liners, either at the propeller or inside the tube, the reason for which is on account of the galvanic action set up between the brass liner and the shaft. A very easy way to break a bar of iron is to nick it all around and give it a sudden blow; and this is what takes place at the ends of the brass liner on propeller shafts, as the line of corrosion forms a ring around the shaft. One would hardly credit the depth this corrosion goes to. To render the galvanic action at the end of the liner less, a good way is to taper the end of the brass liner towards the shaft; but the best preventive is to cover the body of the shaft with tin,

say 5-16 in. thick, between the liners. This is done as follows: The shaft is cleaned up in the lathe and then soldered from end to end to insure the tin adhering to the shaft. A mould is then made around the shaft, which is then made hot and the tin cast around the shaft. It is then turned up in the lathe. This method increases the safety of the propeller shaft by keeping the water from it, and thus preventing galvanic action. The admiralty always cover their propeller shafts with brass liners from end to end, to prevent the water coming in contact with the shaft. In shrinking on those long liners, it is scarcely possible to get a close joint, owing to the shrinkage going in towards the center while cooling. The joint must be caulked, and in many cases is not a satisfactory job, and should water get in through porous metal or bad jointing, the corrosion takes place much quicker than if it was exposed. Many stern bushes have brass strips between each lignum vitæ stave to keep them tight. A good deal of labor is occasioned by this bush, both in casting and fitting in the lignum vitæ. The easiest stern bush to repair is one with two brass strips opposite each other, with the lignum vitæ fitted against them. Care must be taken to have a V cut out between each strip of wood to allow the water to pass into the bearing. Some are of opinion that the lignum vitæ swells when going into the water. I have seen this tested, viz., a stern bush being filled with water stood for six weeks, and when emptied was found by gauge to be precisely the same size, thereby showing that no allowance need be given for the swelling of the wood.

Thrust B'ocks.

The old style of having all solid brass rings in the thrust blocks does not commend itself, as they are very difficult to line up properly when much worn. The best way is to recess the rings in the lathe and fill them up with white metal. The horseshoe rings are most in favor now and are much the easiest to repair. Tinning cast iron is of little use when putting in white metal, as the tinning does not adhere to the cast iron; therefore the white metal has to depend on the dovetailing. In overhauling thrust blocks, some designers entirely overlook the fact that water has often to be used on the thrust, for we often find steel or iron screws and nuts used for squaring up the thrust rings against the face of the collars on the shaft. Corrosion takes place in a few years and makes them impossible to remove, rendering the hammer and chisel necessary to cut them off. Other thrust blocks have steel screws with brass nuts, and are so constructed that it is impossible to use the ordinary spanner to adjust them. There being no room to use a spanner, the consequence is that the hammer is resorted to, burring up the nuts. This is not at all satisfactory. Muntz metal bolts and nuts having a collar, say 1-2 in. thick, would prevent burring, even although pounding with the hammer was resorted to. Those nuts would always bring the shoes to their former position, not allowing them to get twisted, as they sometimes do with common nuts, thereby causing undue wear and a warm thrust.

General Suggestions.

It is not necessary to go over the many minor parts which are constantly passing through the repairing shop, yet, though small and insignificant to appearance, they have to fit into their respective places as accurately as the larger parts, and at times great skill and ingenuity is required in getting the old parts in good order. A lead pattern is preferable to a wood one for intricate work. A perfect mould can be got, and when cast it will be found to require very little fitting. In giving orders for repairs, every item ought to be fully explained and thoroughly understood. Some engineers make drawings of what they want, which is a good idea; word of mouth orders, when passed from one to another, have a tendency to lose some of their specialties. It is not easy to fit work properly, when the steamer is lying a few miles away, with gauges, unless it is understood what travel the gauge has to have in the fitting part. If engineers would give the amount of travel in inches their gauge requires it would often save a great deal of filing on board. A repairing shop ought to be in a position to forge and finish any shaft that may break in any steamer on the coast; also to make new any part of the engine, from the cylinder downwards. As the working parts of an engine get worn first, viz., piston rods, valve spindles, bushes, valve, etc., a great variety of machines ought to be at command to overcome the turning and machining of these parts in the shortest possible time, so that the charter can be kept good or the day of sailing not interfered with.

Spain's Swiftest Auxiliary Cruisers.

In the engravings many of our readers will recognize the former transatlantic liners, Normannia and Columbia, now the Spanish armed cruisers Rapido and Patriota, having been recently fitted out at Cadiz. These splendid steamers were in service, since they were built about eight years ago, between New York and the continent of Europe, and were very popular indeed with transatlantic voyagers.

The "Rapido," which is slightly the larger of the two, was built in 1890 at the yard of the Fairfield Shipbuilding and Engineering Company at Govan on the Clyde. This is the company which built many of the crack Cunarders, and, indeed, the "Rapido" closely resembles the Cunard liners Umbria and Etruria in many essentials. The latter boats, however, are only fitted with single screws. The "Rapido" is 520 ft. long; 57 ft. 6 in. beam, and 38 ft. deep molded, and at 24 ft. draught displaces 11,500 tons. Her gross tonnage is 8,500 tons. She is fitted with four com-

SPANISH AUXILIARY CRUISER RAPIDO—FORMERLY TRANSATLANTIC LINER NORMANNIA.

SPANISH AUXILIARY CRUISER PATRIOTA—FORMERLY TRANSATLANTIC LINER COLUMBIA.

plete decks and a promenade and was designed to carry in all 1,292 passengers. She has twin screws and triple-expansion engines of the three-cylinder, three-crank type, with cylinders 40 in., 67 in. and 106 in. dia., and 66 in. stroke. A longitudinal bulkhead separates the engine rooms, as in our "St. Louis" and "St. Paul," and the "Rapido" has also eleven transverse bulkheads and is subdivided in all into thirteen watertight compartments. With 160 lbs. boiler pressure and 85 revolutions the engines indicated 16,300 horse power. There are three boiler compartments, each containing three double-ended Scotch boilers, 16 ft. dia. and 18 ft. long. Each boiler contains eight furnaces, making 72 in all. The coal consumption is about 300 tons in twenty-four hours at full speed. The propeller shafts are carried outboard and the propellers are 18 ft. 1 in. dia., and 16 ft. 9 in. pitch. One circumstance connected with this vessel, which caused much comment at the time, was that her keel was laid and her trial trip finished within the space of twelve months. She was designed for a sea speed of 19 knots and on trial exceeded 21 knots, but her average speed in regular service was below rather than above 19 knots.

The "Patriota" was built by the Lairds (builders of the Confederate cruiser Alabama), Birkenhead on the Mersey in 1889. Her dimensions are: Length, 480 ft.; beam, 56 ft.; depth from main deck, 35 ft. 6 in. Her gross tonnage is 7,363 tons and at 24 ft. draught her displacement is 10,000 tons. She is fitted with twin screws driven by triple-expansion engines, with cylinders 41 in., 66 in. and 101 in. dia., and 66 in. stroke. With 150 lbs. boiler pressure, and at 74 revolutions, she develops 13,680 indicated horse power. There are nine Scotch boilers, each 15 ft. 4 in. dia., and 17 ft. 2 in. long, each with six furnaces, making fifty-four in all. The coal consumption is about 280 tons a day. The propellers are 18 ft. dia., and 31 ft. pitch. Though smaller than the "Rapido" and with less horse power proportionally her lines are finer and in actual service she is the faster boat.

Both these vessels were originally designed to conform to specifications for German auxiliary cruisers, and were built to carry eight 5.5 in. and four 4.7 in. rapid fire guns as well as several small rapid fire and machine guns. It was reported, however, that since their purchase by the Spanish government they have been strengthened structually by English engineers and will carry 8-in. rapid fire guns in their main batteries.

The new side wheel steamer City of Erie for the Cleveland and Buffalo Transit Co., built at the yard of the Detroit Dry Dock Co., at Wyandotte, Mich., is ready for service. She is a freight and passenger steamer, 324 ft. long; 76 ft. extreme beam, and 18 ft. deep molded. Her engine is of the compound condensing walking beam type, taking steam from six boilers. She is expected to attain a speed of about 21 miles per hour.

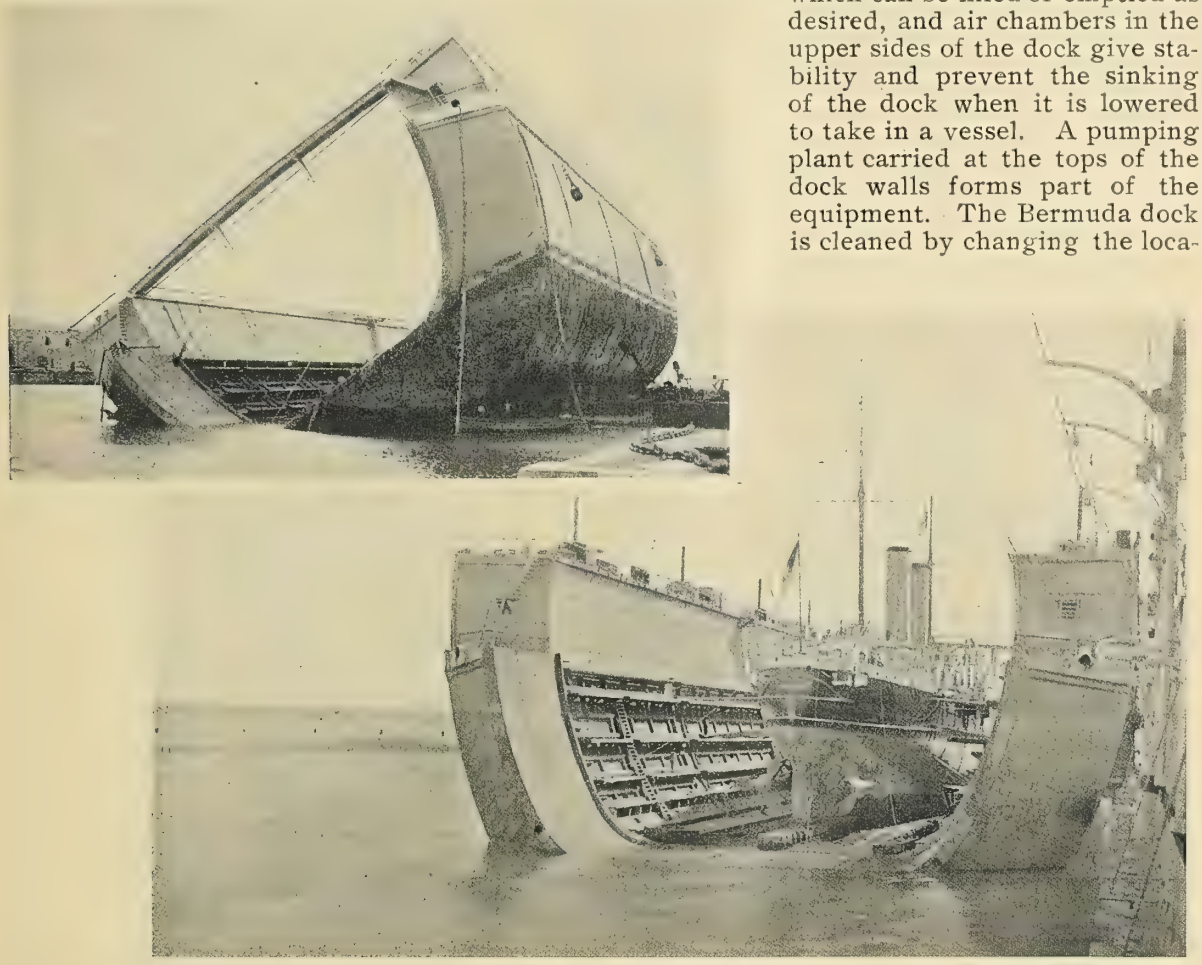
PROPOSED U. S. NAVAL FLOATING DOCK TO BE LOCATED AT NEW ORLEANS.

In the naval appropriation bill Congress recently made an appropriation of $200,000 for the construction of a steel floating and graving dock to be located at the Naval Reservaton at Algiers, Louisiana. Plans for this structure are now being prepared by the Bureau of Yards and Docks under the supervision of Civil Engineer M. T. Endicott, U. S. N. Additional to this amount there is a further appropriation of $650,000 for the necessary expenses of moorings and wharf. This dock will be of great capacity, capable of lifting the heaviest battleship or any vessel up to 15,000 tons displacement and with a draught of 27 ft. of water.

The appropriation has directed present attention to this form of dock. Some critic might consider Congress had been a little premature in providing for this much needed improvement out of American tax-payers pockets. Upon the only possible termination of the present war we shall come into possession of the great floating dock at Havana, which was built not long ago in England and towed out. Spain has always been partial to floating docks, and, indeed, strange as it may now seem, in earlier days she displayed more enterprise in the construction of such docks than any other nation. In home ports she has two large floating docks which, though built more than thirty years ago, should still be in good preservation, unless the proverbial Spanish neglect in engineering matters has made them worthless. A floating dock becomes a necessity in localities where a foundation cannot be made on land except at a prohibitive cost, or where the rock, if such is the coast, is too porous to excavate a safe dry dock.

Floating docks are not by any means a recent invention and it is to American ingenuity that the credit for the development of this form of dock belongs. A hundred years ago floating docks were in use abroad, though these were not entirely independent of land. They were usually sunk between rows of piles, to take on a vessel, so that they would not upset in the process of lifting. In the present century sectional and balance docks were (and are still) extensively used in this country, though invariably built of wood. A wood balance floating dock was built at Pensasola in 1851, which was 350 ft. long, 60 ft. wide on the floor, and had a lifting power of 8,000 tons. About the same time a somewhat larger dock was put into service at Pola, the Austrian naval station. In the modern form, the first iron floating docks of importance were built for the Spanish Government in England by the eminent civil engineer Rennie. This was late in the sixties. These docks were for the naval establishments at Carthagena and Ferrol in Spain. They were of almost similar size, the largest, that for Ferrol, measuring: Length, 350 ft.; beam, 105 ft.; depth inside, 37 ft. 6 in.; breadth inside, 79

ft.; weight complete, 5,000 tons; displacement at base, 13,125 tons. It had a capacity up to 8,000 tons, and with a vessel of about 5,000 tons its draught was about 10 ft. 6 in. At one of these docks, we believe there was an arrangement by which a vessel could be hauled off the dock onto ways on shore, so that more than one vessel could be repaired at one time. About this time, too, a floating dock was built at Cardiff for St. Thomas in the Danish West Indies, a place which has come into prominence during the present naval operations. This dock was 300 ft. long, 72 ft. wide inside and could take in a 4,000 ton vessel of 24 ft. maximum draught.



FLOATING DOCK OWNED BY THE BRITISH GOVERNMENT AND STATIONED AT BERMUDA.

Floating docks of importance were also built during this period in Great Britain for use in East Indian water and at Callao, Peru. These docks were about 300 ft. long. The most notable dock, however, was that constructed on the Thames, for the British Government, to be stationed at Bermuda. This dock is still in active service as will be seen from the accompanying engravings,[1] showing a British war vessel dry docked and also the dock tipped for cleaning.

[1] Reproduced from the Army and Navy, London.

This dock is U shaped, a form which in more recent docks has been replaced by the rectangular form. This latter type is very much like a rectangular box with open ends and without a lid. In the later docks the lower or horizontal portion is made of independent pontoons. These are fastened together by screwed joints, so that any pontoon can be detached and hoisted up or floated on the dock itself, for cleaning and painting. This form of dock also makes possible an increase in dimensions of the structure by the addition of pontoons and the lengthening of the sides. In all these docks the buoyancy or lifting power depends upon the bottom of the dock, which can be filled or emptied as desired, and air chambers in the upper sides of the dock give stability and prevent the sinking of the dock when it is lowered to take in a vessel. A pumping plant carried at the tops of the dock walls forms part of the equipment. The Bermuda dock is cleaned by changing the location of the water ballast so that either side and part of the bottom is exposed. In dimensions this dock measures 380 ft. long; 124 ft. outside width; 84 ft. inside width, and 72 ft. depth over all.

Coming down to recent times the largest dock in the world was built last year at Hamburg by Blohm & Voss. This is 624 ft. long; 118 ft. wide, and has a lifting capacity of 17,500 tons. The pumps of this dock are said to have sufficient capacity to pump it out in forty-five minutes. In its present location at ordinary high tide ves-

sels drawing as much as 26 ft. of water can be docked, though it is capable of lifting vessels of over 29 ft. draught.

German engineers have long made use of floating docks, of which a number are now in use there. A dock of the rectangular form has lately been constructed in England for the Vulcan Works at Stettin, with a capacity of 12,000 tons. This will be first used for the lengthening of two of the single-screw North German Lloyd liners.

The Havana dock also ranks as one of the largest. It is 450 ft. long; 82 ft. in the clear between the altars, and 27 ft. 6 in. deep over the sill. At this immersion the draught is 42 ft. 6 in. and the freeboard 4 ft. 2 in. The pumping plant on this dock is operated by electricity.

Another big dock for the Spanish Government was contracted for early last year, to be located at Olongapo in the Philippine Islands. The contract was let to a Tyneside firm in England, and the intention was to build it in sections and ship these out for erection in position. The dock measurements were: Length, 450 ft.; width over pontoons, 117 ft., and depth, 38 ft. 6 in. It was to be capable of accommodating a vessel 500 ft. long and of 12,000 tons weight. We have no information as to whether or not this dock has been completed. It cannot very well have been delivered and put together in the time which has elapsed since the contract was let, and so probably it will not be useful to Admiral Dewey.

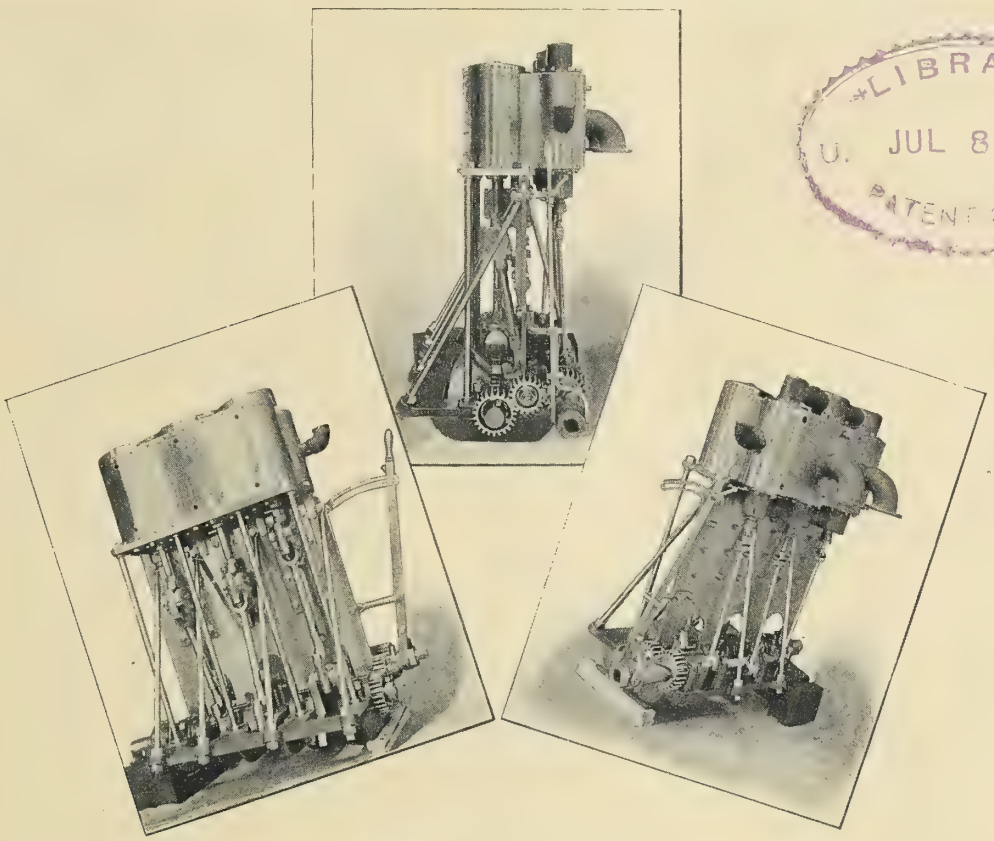
In what might be termed the home of the floating dock its construction has been opposed by persons here who had a voice in the matter. Experience, however, has shown that this type of dock is a very practical one even in the largest sizes. There have been mishaps in the use of these docks just as in all other forms of mechanical constructions. The dock at St. Thomas, here referred to, sunk at its moorings soon after it was put in place and it remained under water for several years, causing the insolvency of its owners. Wreckers finally raised the dock with the aid of compressed air and it was again put to good use. The great dock at Havana also sank not long ago, soon after it was towed across the Atlantic, for reasons not explained. Possibly it had been strained by the long ocean voyage, or more likely the inefficiency of the colonial engineers caused the mishap. No reports as to the present condition of this dock have been noticed.

One advantage which a dock of this form has over those with gates is that if a vessel is too long for the dock proper it is possible to leave the ends projecting, provided, of course, the amount is not so much that the lack of support would strain the vessel. It has also been the practice, frequently, in docking a small vessel in a large dock to float in a pontoon upon which the vessel could be blocked, leaving working space all around, and so avoiding the necessity for pumping the dock entirely out.

COACHING LAUNCH "CORNELL" USED BY THE CORNELL UNIVERSITY ROWING CREW.

COACHING LAUNCH USED BY THE CORNELL UNIVERSITY ROWING CLUB.

is the name of a highly successful and interesting coaching launch shown on page 12, which is used by the celebrated trainer, Courtney, in coaching the Cornell rowing crews on Lake Cayuga. The requirements of a coaching launch differ somewhat from those of a pleasure boat of about the same dimensions. It must have sufficient speed to keep up with or outrun a racing crew, but beyond this rate of speed no increase is necessary. As the highest racing speed of a crew is about 12 miles per hour a speed of 14 1-2 miles was provided for in the design of the "Cornell." Not only has the question of coaching speed to be considered, but the special one of accommodation. The boat must have sufficient size and stability to carry one or more crews, as occasion may demand, and to serve as a landing or embarking stage for crews entering or leaving the shells. In this particular case, too, having in mind the reputation of Lake Cayuga for sudden squalls, the dimensions and form had to be such as would give an entirely seaworthy boat in any weather. There was also a very important little kink in the design, of special interest to propeller sharps, and that is the necessity for having a boat that would gather headway and quickly attain maximum speed. This is a serious defect in many boats of this class. A racing shell with eight muscular men at the oars doesn't lose much time in getting away at the start—racing speed is attained almost instantly. Consequently unless the following launch can attain high speed quickly the distance between the coach and crew will become inconveniently great. In the case of the Cornell launch it is surprising to see how rapidly the launch "jumps" after the shell when the trainer pulls a go-ahead bell. In the construction of such a launch Cornell had a decided advantage over the other universities, in that it had the professional skill of Professor W. F. Durand, principal of the School of Marine Construction of Sibley College, to draw upon.



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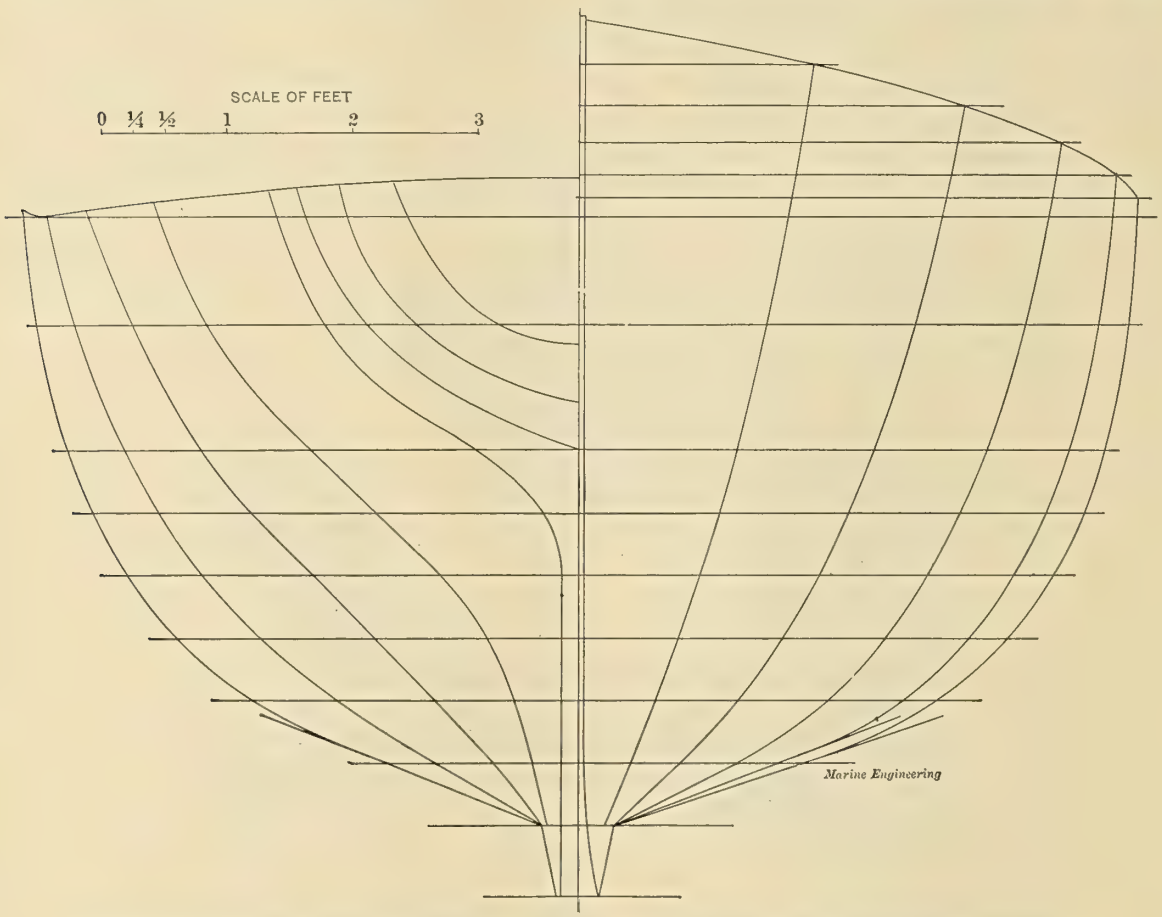
VIEWS OF THE COMPOUND ENGINE OF THE LAUNCH "CORNELL."

The original launch "Cornell" was constructed in the summer of 1894, and was in use during the spring of 1895. About the close of the practice season the house in which the launch was kept took fire mysteriously and the hull of the "Cornell" was destroyed. The rowing committee decided to build a new launch, and the first was so successful that the present "Cornell" was laid down on practically the same lines, during the summer of 1895. The original machinery was overhauled and with a slight replacement of

parts was made as good as new. Since that time the launch has been in regular use each spring and has come to be almost affectionately regarded by the Ithaca oarsmen.

The skill of several persons contributed to the general result. Charles Kellogg, of Athens, Pa., was given the contract for the launch. The engine was designed under his supervision and built by Payne & Sons, of Elmira, New York. The boiler was supplied by George Warrington, of Chicago, and is of his water-tube type. The lines of the hull and propeller were designed by Professor W. F. Durand, and the hull was built by B. F. Taber, of Ithaca, New York.



LINES OF THE COACHING LAUNCH "CORNELL," DESIGNED BY PROFESSOR DURAND.

In detail the principal dimensions and characteristics of the hull are:

Length of water line	56 ft.
Length over all	60 ft.
Maximum beam	9 ft.
Beam at water line	7 ft. 8 in.
Draught including keel	2 ft. 6 in.
Depth of keel	7 in.
Displacement	21,400 lbs. or 9.55 tons
Area of midship section	10.56 sq. ft.
Block co-efficient of fineness	.38
Midship section co-efficient of fineness	.676
Prismatic or cylindrical co-efficient	.562
Water plane co-efficient at L. W. L.	.604
Mean depth co-efficient	.629
Weight of hull	about 12,000 lbs.

The hull is double planked, having two 5-8 in. layers of white pine inside and Georgia pine outside. White oak is used for the frames which are formed or bent to the required shape. White oak is also used for the keel which is made of 7 in. by 9 in. timber. The interior is oil finished in oak throughout.

Both engine and boiler are located amidships, dividing the boat into two sections, with, however, sufficient room on either side for passage between them. The cock pit forward is of large size and is intended especially for the use of the coach in directing the operations of the crew, though he may also make use of the after cock pit, or of the decked over ends at the bow or stern as well.

The boiler shown in outline in the cut herewith is of compact form. In this type the tubes forming the boiler proper are filled with water throughout their entire length. When running, a very rapid circulation is secured, and any deposits are carried down to the mud drum through the down pipes, which are of large diameter. The steam drum is fitted with a centrifugal separator, and in the water drum a blow-off pipe is fitted, to which is attached a conical funnel for the removal of sediment. The boiler data includes:

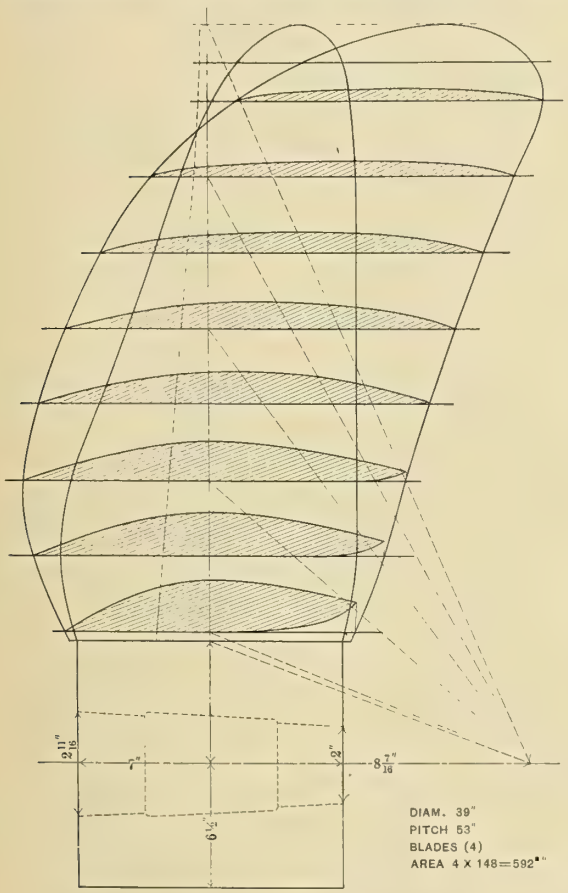
Heating surface	365 sq. ft.
Grate surface	9 sq. ft.
Weight	5,200 lbs.

The engine is of the vertical three-crank three-

cylinder compound type. The two L. P. cranks are opposite at 180 deg. and the moving parts mutually balance. The H. P. crank is at 90 deg. with these and is provided with a crank counterbalance for its moving parts. The combination as a whole gives a well balanced engine, producing but little vibration at any speeds at which it has been run. The chief dimensions and characteristics of the engine are:

Dia. of cylinders	one H.P. 6 in., two L.P. each 8 3-4 in.
Stroke	8 1-2 in.
Ratio of L.P. to H.P area	4.25 to 1
Total number of expansions	about 7
Steam pressure at H.P. cylinder	200 lbs.
I.H.P.	100 at about 375 rev. per. min.
Main steam pipe, dia	2 in.
Exhaust pipe, dia	two 3 1-2 in.
Piston Valve, H.P., dia	2 3-4 in.
Piston valve, L.P., dia	two 4 7-8 in.
Front columns	four steel rods 1 1-16 in. dia.
Rear support	steel plate 5-8 in. thick
Oblique braces add further to the transverse support.	
Pistons, cast steel	3-8 in. thick
Piston rings	two 7-16 in. face
Piston rod, dia	1 1-8 in.
Crosshead pin	2 3-8 in. long by 2 1-8 in. diam.
Slide surface	8 in. by 4 5-8 in.
Connecting rod, length	23 in.
Connecting rod, dia	1 5-16 in. and 1 1-2 in.
Crank pin	3 1-4 in. long by 2 7-8 in. dia.
Crank webs	3 1-2 in. wide by 1 1-2 in. thick
Crank shaft, dia	2 7-8 in.
Thrust surface	33 sq in.
Weight of engine and auxiliaries	4,000 lbs.

The valve chests are placed on the sides of the cylinders and the valves are operated by a valve

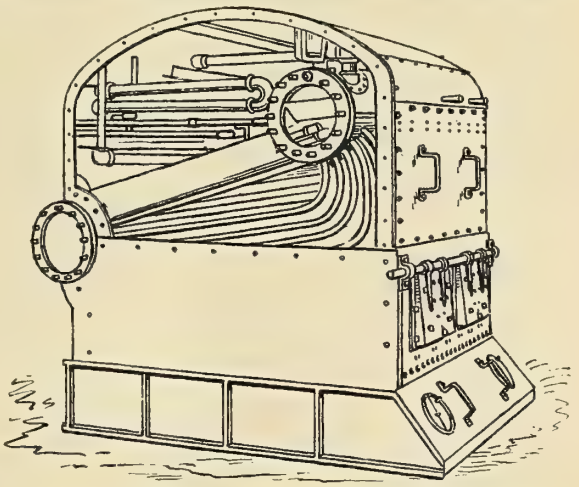


PROPELLER OF LAUNCH "CORNELL"

shaft given motion from the main shaft by means of spur gearing as is common with gears of this type. Phosphor bronze was intended to be used for the propeller, but questions of local convenience caused the substitution of cast iron. The propeller data is:

Diameter	39 in.
Pitch	53 in.
No. of blades	4
Helicoidal area	592 sq. in. or 4.11 sq. ft.

The auxiliaries include a compact Wheeler cylindrical condenser, a combined air and circu-



WATER-TUBE BOILER IN LAUNCH "CORNELL."

lating pump of these dimensions: Steam cylinder, 4 1-2 in. dia. by 6 in. stroke; water and air cylinders, 6 in. dia. and 6 in. stroke, and an independent feed pump and injector.

Steering is effected by a wheel fitted to a bracket on the bulkhead in the forward cockpit from which the tiller ropes are carried aft by the usual guides.

The launch "Cornell" was designed to have a maximum speed of about 14 1-2 miles per hour, or a sustained speed of 14 miles. These requirements have been more than fulfilled, though in a general way the results correspond closely to the expectations of the designer. A speed of 14 1-2 miles is readily obtained with about 90 I. H. P. and 360 revolutions, while a moderate cruising speed of 12 miles may be maintained with about 50 I. H. P. and 280 revolutions.

The battleship Alabama was launched at Cramp's shipyard, in Philadelphia, May 18. This fine vessel is 368 ft. long, 72 ft. 2.5 in. beam, and has a mean draught of 23 ft. 6 in., on a displacement of 11,525 tons. She will be fitted with twin screws, driven by engines of 10,000 I. H. P., with which a moderate speed of 16 knots is expected. She is protected with armor of thickness varying from 17 in. to 2.75 in. In her main battery she will carry four 13-in. breech-loading rifles and fourteen 6-in. rapid-fire guns. Her secondary battery will include sixteen 6-pounder and four 1-pounder rapid-fire guns, and one Colt and two field guns. She will have also four long Whitehead torpedo tubes. Her keel was laid December 1, 1896, and her date of completion is set for September 24, 1899.

CONCERNING THE NEW NORTH GERMAN LLOYD LINER KAISER FRIEDRICH.

When the new North German Lloyd liner Kaiser Friedrich left Southampton for New York June 8, it was confidently expected by many that if she failed to break the fastest passage record she would at least make a new maiden trip record. Her builder, F. Schichau, of Elbing, Prussia, was known to be an expert in the construction of fast steaming vessels, and, besides, he was on his mettle, for his German rival, the Vulcan Company, had exceeded all previous performances with the "Kaiser Wilhelm der Grosse." When record time was reached, and the new liner Kaiser Friedrich had not been sighted, on this side, these expectations gave place to a hope that a fast ordinary trip would be recorded. Another disappointment was in store, however, for not until early on the morning of June 15 did the big liner pass in at Sandy Hook. Her corrected time for the trip then stood at 7 days, 10 hours and 15 minutes. As the course run was 3,163 knots, this gave a rate of speed of only 17.74 knots. Later, when the liner tied up at her dock in Hoboken, it was learned that she had been delayed by trouble with the machinery. The extent to which this affected the trip is seen on an inspection of the daily runs, which were: 406, 442, 395, 472, 378 and 460 knots. The "Kaiser Wilhelm der Grosse" has a daily run of 580 knots to her credit. It was at once manifest that the trip across gave no line whatever upon the capabilities of the ship.

Before referring at any length to the causes of the delay it will be well to note some of the dimensions and chief characteristics of this splendid ship. In many respects she is a distinct departure from the usual type of transatlantic liner. The experience her builder has gained in the construction of fast war vessels was turned to account in this ship, and several novelties of design are the result. Indeed this shows that originality and boldness in departure from traditional methods which frequently marks distinct progress. In general dimensions the Kaiser Friedrich is 600 ft. long, 64 ft. beam and 41 ft. deep from keel to upper deck. Her gross tonnage is 12,000 tons, and displacement at 28 ft. draught 17,000 tons. In form she is extremely fine at the ends, with a remarkably sharp straight entrance. Her funnels are three in number, elliptical in section, and she has two pole masts, the combination making an extremely trim looking vessel, in which the only disfigurement is a multiplicity of cowls above the boat deck. A watertight double bottom is worked the entire length of the vessel, and the hull is divided into eighteen watertight compartments by seventeen bulkheads, of which fifteen extend to the upper deck and two to the main deck. It is calculated that should any three compartments be flooded simultaneously, the vessel would still retain sufficient buoyancy to float.

The "Kaiser Friedrich" has been constructed in accordance with the German Lloyd's rules, also those of the United States Government, and she meets the special requirements laid down by the Imperial German Navy for the construction of auxiliary cruisers. These include the laying out of gun emplacements and local stiffening of the hull, and special construction of rudder and location of steering gear. In the machinery department the chiefest novelty is to be found. The engines are located about 15 ft. further forward in the ship than usual in liners. They are of the five-cylinder, three-crank, quadruple-expansion type, together capable of developing 25,000 indicated horse power. In dimensions the cylinders are: high pressure 43.34 in. dia., first intermediate 64.20 in. dia., second intermediate 92.20 in. dia. and (two) low pressure 93.58 in. dia. by 66.975 in. stroke. The sequence of cylinders is: high pressure and low tandem over forward crank, second intermediate over middle crank, and first intermediate and low pressure tandem over after crank. Piston valves are fitted to the high pressure and first intermediate cylinders and single ported Trick slide valves to the others. Upon descending into the engine room the visitor can hardly believe his eyes that he is aboard a big liner; he rather fancies himself in the engine room of some great war vessel. The engines are designed upon the lines of those now invariably fitted in warships, with turned steel columns 10 in. dia. instead of the usual heavy looking columns, and in fact no cast iron is in sight except the cylinders and valve chests. The crank shaft bears out the illusion, as it is of the design now used in our naval vessels. Each engine shaft is made in three pieces, of Krupp's nickel steel, and is 42 ft. 6 in. long, by 23.64 in. dia. in the bearings. The crank pins are 29.15 in. long, and 23.64 dia., with a 8.67 in. through hole; the outside corners of the slabs at the pin ends are chamfered. This tends to give the crank a light appearance, in striking contrast to the ponderous built up cranks on many other liners. The connecting rods are 12 ft. 5.7 in. long, center to center. Stephenson link motion is fitted throughout, and there is a single eccentric on each shaft for working an expansion valve. These valves were found to be too effective in practice, and were removed at Southampton on the trip out. Air, bilge, and cold-feed and sanitary pumps are fitted to the main engines and worked in the usual way, by rocking levers. There is a full equipment of auxiliaries, including a hot feed system, and various fire, bilge, ballast, sanitary and centrifugal circulating pumps. The location of the engines so nearly amidships necessitated the use of rather longer shafting than usual in a vessel of this power. Over all, the starboard shafting measures 244 ft. 4 in., and, as the propeller blades overlap slightly, the port shafting measures 247 ft. 9 in.

Coming back now to the cause of delay on the voyage across; this was due entirely to the failure of the slide valves to work smoothly and to the

breakage of studs in the air pump buckets, so that a proper vacuum could not be maintained. With slide valves of the single ported type, the travel is extensive, and this, with the great dimensions of valve necessary, and the rapidity of the stroke (86 engine revolutions at full speed) caused excessive wear. It is probable that the relief frames became practically useless, as a consequence, leaving the entire backs of the valves exposed to the receiver pressures. The tremendous strain thus thrown upon the rods and gear would make a reduction in speed of engine revolutions an act of common prudence. A slide valve of these dimensions, even when of the multiple-ported type, with comparatively little travel, is an unpleasant piece of mechanism in an engine room. German engineers, however, as a class, seem to favor the slide valve for the low pressure cylinders of large engines. The difficulty with the air pumps was one which might, perhaps, have been anticipated. The buckets are of a long familiar type, with heavy metal valves held in place by phosphor bronze studs. At the high rate of engine speed at full power the hammering effect of the water broke off studs close to the bucket, causing, of course, serious leakage. This is not a new experience by any means in marine work and could likely be easily remedied by the substitution of metal discs, or similar valves, for those now in use, without any alteration of the pump itself.

Under the circumstances it is not a matter of wonder that the "Kaiser Friedrich" did not break any records; but rather her time for the voyage is a high testimonial to the skill of the chief engineer, Herr Ottomar Michael and his staff. During the voyage no trouble whatever was experienced with the shafting, either crank, thrust, or line.

In the boiler equipment will be found another departure from the orthodox. A boiler room has been placed aft of the engines. There are ten boilers in all in the ship. Nine of these are double-ended and one single-ended. Three double and the single are fitted in the forward boiler compartment, three double in the compartment next aft and three double in the compartment aft of the engines. Eight of these boilers are 16 ft. 8 in. dia. and 21 ft. 3 in. long, and are fitted with eight furnaces each. One furnace in each end opens into a common combustion chamber and the grates are unusually long. The furnaces are Purves' ribbed and the tubes are plain, fitted with spiral retarders. In the after compartment, abaft the engines, there are two boilers of these dimensions, one on each side, and in the center one smaller boiler with six furnaces only, which is set across the tops of the tunnels. The pressure carried is 225 lbs. per sq. in. Howden hot draught is fitted to all the boilers.

The propellers are three bladed, made of manganese bronze, with adjustable blades, and are 20 ft. 4 1-2 in. dia. and have now 31 ft. 5 1-2 in. pitch. They turn out when going ahead.

An inspection of the machinery equipment produces in the visitor, of mechanical perception, that indescribable feeling of satisfied contemplation which artists are said to experience on viewing a masterpiece. There is the mark of the trained draughtsman and mechanician on everything visible; not only do general outlines harmonize and show good geometrical proportions, but little details are worked out with true engineering skill. The only criticism, indeed, which can manifestly be made, is that there has been a too rigid economy of space, which, however, from the owners' and passengers' points of view is a merit. It is greatly to be regretted that such a splendid ship should have been sent to sea without adequate trials, and thus have been subjected to undeserved criticism by non-technical persons. Fine warship performances, which most Navies refer to boastingly are, notoriously, made only after it has been carefully ascertained that the ship will do what is expected of her. A 3,000 mile trial trip at full power is a serious ordeal for a new vessel, in which the designer has incorporated some original ideas. Prophecy is a dangerous rock, but we would feel quite safe in asserting that if the "Kaiser Friedrich" does not "break the record" she will come so near it that chronographs will have to be used to decide who wins.

It has been decided by North German Lloyds to send the vessel on her homeward trip without passengers, June 25. Using the high pressure and first intermediate cylinders, which are fitted with piston valves, the engines will be run compound, and a speed of 10 knots is looked for.

Vessels Recently Added to the Navy.

We here publish a list of vessels recently purchased by the Navy department not included in the lists which appeared in our May and June issues. Since the publication of the June list changes have been made in the names of the former revenue cutter Algonquin and the tug El Toro. The El Toro was among the vessels first purchased by the Navy and was then renamed the Algonquin. Later, when the revenue cutter Algonquin was transferred to the Navy, the renamed tug Algonquin (formerly El Toro) was at sea, and it was decided to rename the revenue cutter Algonquin the "Accomac" so as to avoid confusion in orders. This change was not acceptable to the Treasury officials and a change of names was again effected by which the name "Algonquin" was restored to the revenue cutter and the name "Accomac" transferred to the former tug El Toro (temporarily the Algonquin).

In the June issue the new name of the Galveston tug Hortense is omitted. This boat is now known as the "Takoma."

Various other vessels have been inspected by the naval board organized for this purpose. The lists published include those actually in service.

WARSHIPS AND AUXILIARY VESSELS RECENTLY ACQUIRED BY THE UNITED STATES NAVY BY PURCHASE, CHARTER OR TRANSFER (*THIRD TABLE*).

Old Name and Date.	Old Class.	Length.	Breadth.	Depth.	Draught.	Tonnage.	Horse Power.	Speed, Knots.	Where Built.	Hailing Port.	Former Owners.	New Class.	New Name.
Atala, '94	Steel freighter	330	43	26 3	....	3,250 reg.	267 N.	9	Stockton, England	London	New Blue Star Line, Ltd	Collier	Alexander
A. W. Booth, '98	Steel Tug	92 10	19	10	8	208 disp.	300	10.5	Seattle & Levy	New York	Michael Moran	Tug	Massasoit
City of Peking,* '74	Transpacific liner	423	48	27 8	....	5,080 gross	....	14	John Roach	San Francisco	Pacific Mail S. S. Co.	Miscellaneous	City of Peking
Comanche, '92	Auxiliary yacht	184 6	25	14 3	11	357	550	11	Globe Iron Works	Cleveland	H. M. Hanna	Aux. gunboat	Frolic
Dorothea, '98	Yacht	215	23 3	15	10	.....	...	16.5	Cramp	Philadelphia	Estate of Thos. McKean	" "	Dorothea
East Boston, '92	Twin Sc. Ferry	163	57	14	8 10	762 gross	700	12	East Boston	Boston	Street Dept., Boston.	Lighter	East Boston
Enquirer, '96	Yacht	143 7	17 6	10	6	140 56	...	18	UnionDryDock,Buff.,N.Y.	Buffalo	J. W. Connors	Aux. gunboat	Enquirer
Eugenia	"	149 6	19	11 6	10	165 gross	360	11.75	Leith, Scotland	Philadelphia	J. G. Cassatt	" "	Vixen
Governor Russell, '98	Twin Sc. Ferry	164 3	57	14 1	9	713	700	12	East Boston	Boston	Street Dept., Boston	Lighter	Gov. Russell
Huntress, '95	Yacht	120	16	9	6 6	81.76	650	16	C. L. Seabury	Hartford, Conn.	F. C. Fowler	Aux. gunboat	Huntress
Inca, '79	"	92 6	20	9 5	7	103 gross	200	12	Philadelphia, Pa.	Brunswick, Ga.	South Atlantic Tow. Co.	" "	Inca
J. D. Jones, '89	Wood Tug	140 9	29	12 4	11 6	298 gross	525	10	Tottenville, N. Y.	New York	Merritt Wrecking Co.	Tug	J. D. Jones
Kate Jones, '79	Iron tug	102 5	20	10 6	....	122 gross	125 N.	....	Camden, N. J.	Boston, Mass.	.....	"	Seminole
Peter Jebsen, '91	Freighter	321 5	41 5	21 9	....	3,070 gross	283 N.	8	South Shields, England	Bergen	Bergh & Heiland	Collier	Brutus
Rhaetia,† '83	Steel freight and pass'r steamer	351 6	43	29	....	3,458 gross	440 N.	10	Hamburg, Ger.	.....	.....	"	Cassius
Scindia, '90	" "	375	46	27	....	4,358 gross	440 N.	12.5	D. & W. Henderson, Glasgow	Glasgow	Henderson Bros.	"	Scindia
Shearwater, '87	Yacht	1 0	18	10	8	109 gross	220	11	Boston, Mass.	New York	H. R. Wolcott	Aux. gunboat	Shearwater
Stranger, '80	"	190 5	23 8	11 6	10 6	247 gross	...	....	Cramp	"	Mrs. Mary Lewis	" "	Stranger
Whitgift, '95	Steel freight and pass'r steamer	312	41	20 6	....	2,925 gross	246 N.	9	Sunderland, England	London	Houlder, Middleton & Co.	Collier	Nero

* Sailed with Stores, etc., for Admiral Dewey's Squadron.

† Formerly in Hamburg-American Fleet.

Additional Particulars of the Manila Fight.

The story of the sea fight at Manila told by the cables has been supplemented during the month by details brought by mail. Indeed the Navy Department has received the official report of Admiral Dewey, and many letters from officers and men of the American squadron have been received by their friends at home. Most interesting of all, however, are the sketches of the wrecked Spanish vessels made on the spot by John T. McCutcheon, the special artist-correspondent of the *Chicago Record*. Through the courtesy of this metropolitan newspaper we are enabled to vividly show our readers the actual effects of the American fire.

Mr. McCutcheon was on board the Revenue Cutter McCulloch, which accompanied the squadron from Hong Kong to Manila and which, thought it did not participate in the fight, remained within visual distance guarding the transports, and after the fight rejoined the other vessels. One of the views shows the incident of the fight referred to by Admiral Dewey in his report thus: "At 7 A. M. the Spanish flagship Reina Christina made a desperate attempt to leave the line and come out to engage at short range, and was received with such a galling fire, the entire battery of the "Olympia" being concentrated upon her, that she was barely able to return to the shelter of the point. The fires started in her by our shell at the time were not extinguished until she sank."

In his report of the Manila fight Admiral Dewey states that the American squadron opened fire at 5.41 A. M., May 1, the range varying from 5,000 to 2,000 yards as the fight proceeded. At 7.35 A. M. his ships ceased firing and withdrew for breakfast. At 11.16 o'clock he returned to the attack, at which time the Spanish flagship, and almost all the Spanish fleet, were in flames. At 12.30 P. M. the squadron ceased firing, the land batteries being silenced and the enemy's ships sunk, burned, or deserted. Afterwards the gunboat Petrel was sent to complete the destruction of the gunboats sheltered by the point of Cavite. "I am unable to obtain complete accounts of the enemy's killed and wounded," continues Admiral Dewey, "but believe their losses to be very heavy. The "Reina Christina" alone had 150 killed, including the captain, and 90 wounded." Mr. McCutcheon writes to the *Chicago Record*, after a careful investigation, his belief that 400 were killed and 600 wounded.

During the engagement the Spaniards fought with the most desperate bravery, which makes our victory all the more creditable. Their firing, however, while rapid was ineffectual, owing to wretched aiming, and Admiral Dewey reports: "the damage done to the squadron was inconsiderable—none killed and only seven men slightly wounded. Several of the vessels were struck and even penetrated, but the damage was of the slightest."

1
McCutcheon - MAY 1 -
2
McCutcheon - MAY - 2 - CAVITE
3
McCutcheon - U.S.S. McCulloch - MAY 2 -
4
McCutcheon - CA. I.T. - MAY 2.
5
McCutcheon - MAY 1 - From U.S.S. McCulloch -

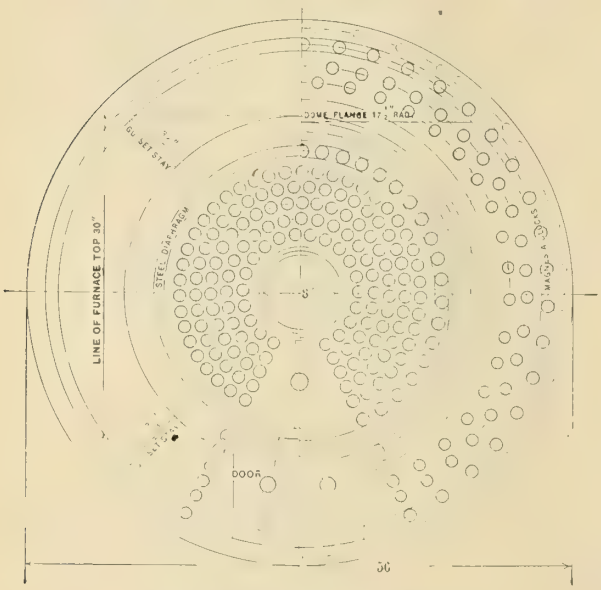
1. Wreck of wooden cruiser Castilla in Canacoa Bay.
2. Wreck of steel cruiser Reina Christina, Admiral Montejo's flagship.
3. Sailors from U.S.S. Olympia blowing up a shore battery.
4. Wreck of the iron cruiser Don Antonio de Ulloa in Canacoa Bay.
5. U.S.S. Olympia driving back the Spanish flagship which had come out to meet her.

WITH ADMIRAL DEWEY AT MANILA.—COPYRIGHT, 1898, BY THE *CHICAGO RECORD*—REPRODUCED BY PERMISSION.

IMPROVED APPATATUS.

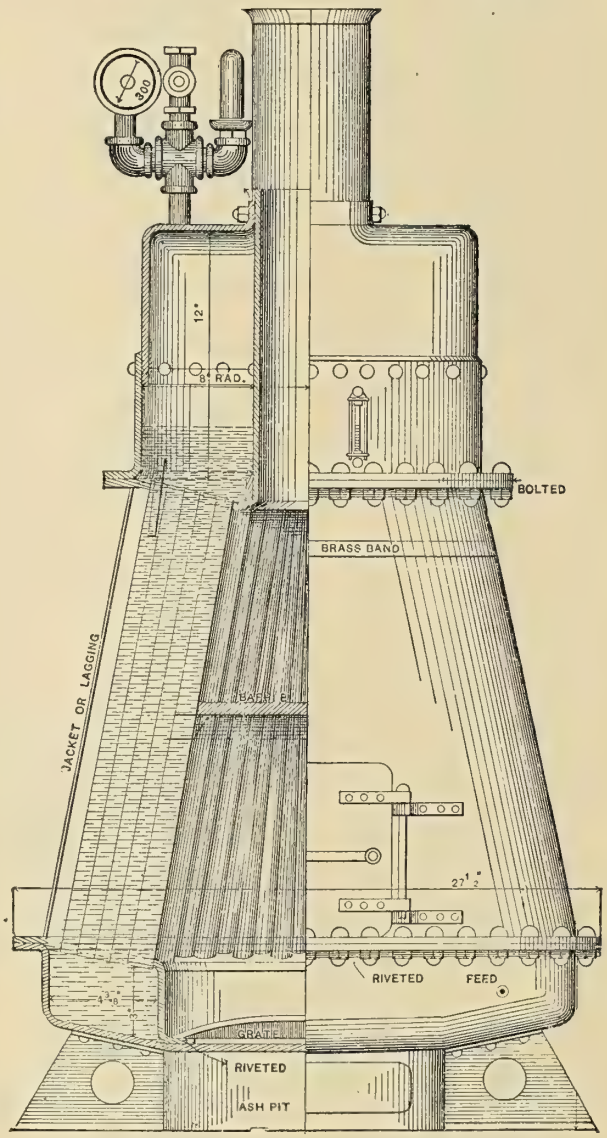
Watson Radial Water-Tube Boiler.

The construction of the Watson water-tube boiler is very plainly shown in the accompanying engravings. The tube system is in the form of a cone, inclined over a central furnace, the gases from which are diverted between the tubes by a baffle-plate, in the upper part, directly under the smoke-pipe. The tubes are secured in place by expanding the ends in the tube sheets, which are inclined so that the tubes are at right angles to them. The smoke-pipe is screwed into the tube-sheet and passes through the steam dome, to which it is connected on the upper end—where it emerges—by a metallic packed slip-joint, and by bolts passing through the neck of the slip-joint at right angles. The various elements are riveted together, with the exception of the flange connecting the steam dome with the boiler proper.



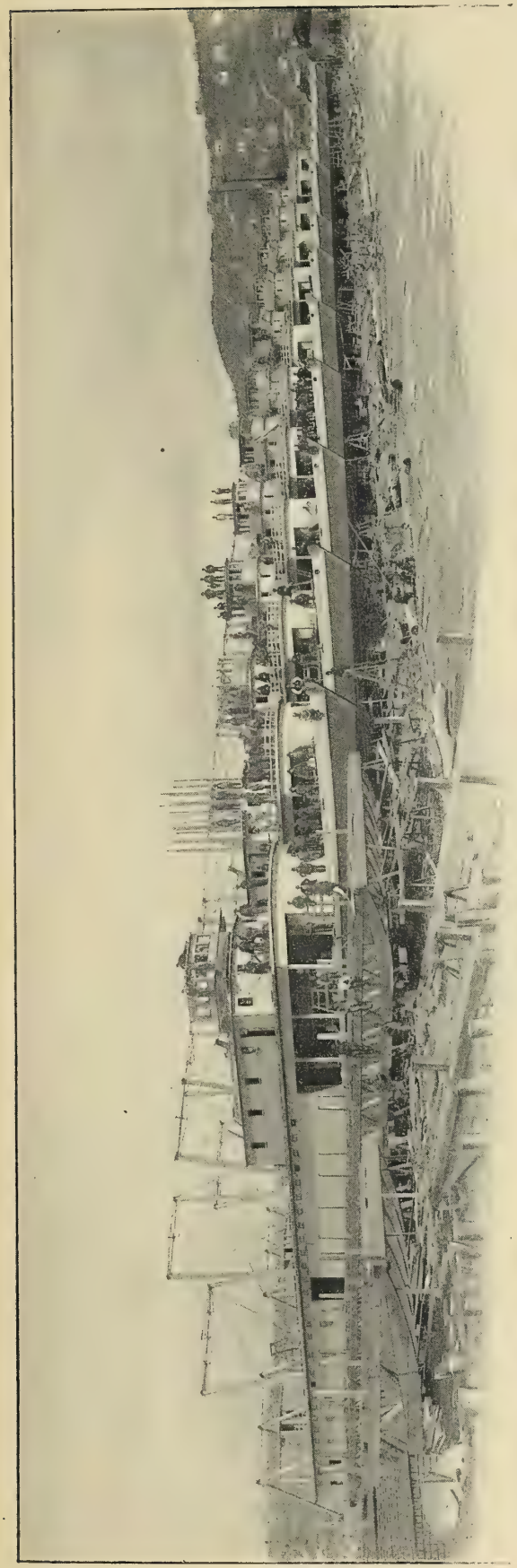
PLAN OF THE TUBE SYSTEM.

This is bolted together and so is readily removable for cleaning and inspection of the interior. To secure a rapid and constant circulation a steel plate diaphragm is introduced between the outside row of tubes and the inner rows and extending from top to bottom, with the exception of the fire door opening. Consequently the down cast tubes receive no direct heat from the furnace and are comparatively cool. The water rising through the steam tubes passes over into the downcast pipes to the water bottom. Here any impurities held in suspension are deposited and can be readily blown out. The grates—which are put in through the door—and the ash-pit are easily accessible. The latter is bolted to the water bottom and can be easily removed and renewed when worn out. All boilers are constructed throughout of marine steel of 60,000 lbs. tensile strength and are built to pass government inspection and to carry 225 lbs. per sq. in. working pressure. The manufacturer guarantees a rate of evaporation of 6 to 8 1-2 lbs. of water per pound of good coal, according to the conditions which prevail on trial. He has subjected one of these boilers to severe tests, such as letting the water get below the gauge cocks and severely forcing the boiler beyond its capacity without any serious results. In water-tube boilers the contained water is very small in quantity, but in this type the contained water is 30 per cent of the weight of the boiler empty. On a test with a boiler having 2.75 sq. ft. of grate surface and 82 sq. ft. of heating surface, a rate of evaporation of 170 pounds of water per sq. ft. of grate



SECTIONAL SKETCH WATSON BOILER.

surface, with feed water at 40 deg., was reported. The stack used was 36 in. high, and the draft did not exceed 1-2 in. of water. On an engine consumption of 30 pounds per hour this would give 17 horse power, or a horse power for every



STERN-WHEEL STEAMBOATS FOR THE YUKON, UNDER CONSTRUCTION IN THE YARD OF MORAN BROS., SEATTLE, WASH.

5 sq. ft. of heating surface. Emphasis is laid by the manufacturer upon the light weight and small dimensions of the boiler for a given horse power, when compared with tank boilers. The boiler shown in the elevation has 100 sq. ft. heating surface; 3 sq. ft. grate surface. Its total height is 5 ft. and extreme width 3 ft. 11 in. and the weight laid down ready to steam is 1,300 pounds. This boiler is sold under a guarantee that it will come up to contract requirements. The inventor, patentee, and manufacturer is E. Pomeroy Watson, Elizabeth, N. J.

Proposed U. S. Seagoing Battleships.

Bids will shortly be called for by the Navy Department for the three seagoing coast line battleships recently authorized by Congress. The following general characteristics will be embodied in the designs proposed by the Department: Length, on load-water line, 368 ft.; beam molded, at water line, 72 ft.; mean draught at normal displacement, 23 1-2 ft., normal displacement about 11,500 tons. They will carry armor varying from 16 1-2 in. to 2 3-4 in. in thickness, according to position. The main batteries will consist of four 13-in. B. L. guns, mounted in barbette turrets, one forward and one aft, ten 6-in. R. F. guns in broadside on the main deck, and four on the upper deck within the superstructure. The secondary batteries will consist of twenty-four R. F. and machine guns. These ships will have twin screws, single-ended cylindrical boilers and the bunker capacity will be 1,200 tons. They will have a sea speed of 16 knots. Heavy penalties will be imposed for any deficiencies in speed at the time of trial.

Stern Wheel Yukon Steamers.

A round dozen large river steamers under construction in the yard of the Moran Bros. Company, at Seattle, Washington, are shown in the accompanying engraving. The keels for all these vessels, which are intended for Yukon river trade, were laid since January 1 last. They are alike in all particulars of dimensions, material and equipment. The principal dimensions are: Length, 175 ft.; beam, 35 ft.; depth of hold, 6 1-2 ft. Each is fitted with a stern wheel, with engines having cylinders 20 in. dia. and 84 in. stroke, and three cylindrical tubular boilers 44 in. dia. and 16 ft. long, with 82 2 1-2 in. tubes. These vessels are fitted with steam capstan, steam and hand steering gear, and electric light throughout, including a 2,000 candle power searchlight in the pilot house. Each has cabin accommodation for twenty-four passengers and "standee" berthing on the main deck for 200 more. All freight is carried in the hold. The freight carrying capacity of each steamer is 400 tons on 48 in. draught. The hulls and all the machinery, with the exception of the pumps and electric lighting sets, were constructed by the Moran Bros. Company.

MARINE ENGINEERING

PUBLISHED MONTHLY

BY THE

MARINE PUBLISHING COMPANY,

World Building New York.

H. M. SWETLAND, President and General Manager.
H. L. ALDRICH, Vice-President and Business Manager.
A. B. SWETLAND, Treasurer.
H. F. DONALDSON, Secretary and Editor.

Southern Representative.
S. W. ANNESS, Philadelphia, Pa., Machinery Dept., The Bourse.

Western Representatives.
L. L. CLINE, Detroit, Mich., 47 Hodges Building.
B. M. GARDNER, Chicago, Ill., 1522 Monadnock Block.

Traveling Representatives.
E. L. BLANCHARD. A. B. FLETCHER.

SUBSCRIPTION:
Domestic, $2.00. Foreign, $2.50. Single Copies, 20 cents.

Entered at New York Post Office as second-class matter.

ONE result of the naval operations, so far, has been a better understanding by the public of the duties and responsibilities of the staff officers of the Navy. In peace time they were, of course, in the background, while their brethren of the line were equally prominent on all occasions of social or professional occupation ashore or afloat. It was the captain and his corps of line assistants who, in splendid blue and gold, welcomed the influential visitor at the side and showed him or her the methods of handling those dreadful guns, and other terrible engines of destruction. There were places in the ship, and spacious ones, too, in which strange masses of metal were stored; but these were dark and uninviting and smelled like a scullery, and usually the visitor did not investigate. It was in these dark and cavernous engine and boiler rooms that the engineer—plain Mr. So and So—was usually hidden. It is a peculiarity of the engineering branch of marine work that, frequently, its members have more to do when in port than when under steam. A deck officer can dismantle a gun when the vessel is steaming at full speed, while no engineer can take an engine adrift under the same conditions. In fact, in his case, it is the work done in port which makes possible the speed of the ship at sea. As we remarked, the lessons of the past weeks have had a distinct educational value. There has been the spectacle of the ships of the Spanish Navy, with powerful batteries and manned by brave officers and men, useless for offensive operations, because either their machinery was not in condition to put to sea or when running was beyond the capability of the engineers to properly control. On our side there have been the magnificent demonstrations of engineering skill in the home runs of the "Marietta" and the "Oregon." The 13,000 mile run of the latter from San Francisco 'round the Horn to Jupiter Point, Fla., where she cast anchor in American waters again, is an achievement that shows what our engineer officers are capable of. No delays were experienced other than the brief stops in port, on the way, to provision and coal; and at the end of her trip, after coaling up, she was ready to take her place in line of battle. And the little "Marietta," a thousand ton gunboat, made an almost continuous trip from Sitka, Alaska, to Key West, Fla., commencing on December 9, 1897. and ending June 4 last. Coming to personal deeds what words can give proper credit to the bravery of Richmond Pearson Hobson, a member of the distinguished corps of naval constructors? In this connection the professional courtesy of Admiral Sampson, in giving Mr. Hobson the opportunity to carry out his plan of sinking the "Merrimac," in the fairway at Santiago, should not be forgotten. Contrasting the work of our ships in actual warfare with that accomplished by foreign vessels during peace manoeuvers, the results are a cause for great satisfaction. Not a vessel of importance has seriously broken down in its machinery equipment, while in the foreign manoeuvers there were invariably many serious mishaps.

THERE is, perhaps, no form of apparatus for marine use which has a greater future than the internal combustion engine, usually termed the gasoline or gas motor. The growth of this branch of construction indeed has been remarkable, but if signs go for anything the business has made little progress compared with what is to come. Hitherto the application of the gas motor has been confined largely to pleasure boats, but improvements in design and construction, on the part of the manufacturers, and a better appreciation of the possibilities of this form of engine, on the part of the user, are ever increasing the range of application to purely commercial uses. In the line of pleasure craft, however, which we have more in mind here, there is

a great future. Persons who cannot afford the initial expense and cost of maintenance of a small steam yacht can now get a comparatively inexpensive boat which will not heavily tax their incomes for upkeep. Such persons desire to own a boat in which they can entertain themselves and their friends with the social privacy which is not possible in excursion or pleasure steamers however well appointed. Nor do they care for the pleasures of the sail boat, which, if spacious compels the carrying of a crew, either amateur or professional, and which is decidely inefficient in manoeuvring capacity in the best of weather, and a conveyance of questionable comfort in calm or storm. With the motor boat there is a source of power independent of wind and tide, and provided a few simple preliminaries, such as keeping a full oil tank, are attended to, it is ready for immediate service at any time of day or night. There are no fires to light nor sails to set and no delays other than a few brief moments to start the motor. If the owner is fond of things mechanical he can act as his own engineer without fear of the law. In connection with the growth of this branch of marine construction there is one feature which is detrimental and which cannot be reasonably explained. We refer to the hugger mugger methods of some motor builders. When an intelligent customer comes along, and the prospective purchaser of a motor boat is usually a man of more than average intelligence, he is treated to a plausible, if not garrulous, explanation of the merits of the apparatus, but when explicit information is asked for it is not forthcoming. If the customer is versed in mechanical matters he is more or less disgusted, and if he is innocent of such knowledge he is very likely to be imposed upon, and later becomes an enemy rather than a friend of this mode of propulsion. Let us illustrate this matter by an actual occurrence. At a recent exhibition in New York a gentleman of our acquaintance, who is particularly well informed on engine construction, and who had received a commission from a friend to purchase a marine motor, approached an exhibitor. The general appearance of the motor exhibited rather impressed our acquaintance, and after some general inquiries as to power and weight, etc., he asked for details of the valve gear. On this the exhibitor flew into a furious passion and demanded to know by what right his questioner had made such an inquiry. The gear was the result of many years labor of the exhibitor and patentee, and it was little short of infamous to ask him to divulge these marvelous details. When he had finished our acquaintance inquired: "Do you suppose I would purchase an engine upon your assurance that it was 'all right,' and that it 'would do the work,' without making any investigation and forming my own judgment?" When the exhibitor found that a sale was in jeopardy he tried to justify himself, though still declining to give any technical description of his engine. This is not an isolated case, for other manufacturers maintain a Chinese attitude when questioned, and try to cover their actions by vague talk about the insecurity of the patent system. Contrasting this conduct with that of the steam-engine builder the inference is such gas motors are like Peter Pindar's razors—made to sell. There is no law which would prevent any one so minded from purchasing any type of motor in the market and disconnecting it at his leisure, with calipers and rule at hand. Reputable builders of steam engines desire the customer to know exactly the design and advantages of an engine down to the minuetest bolt, and why should not this apply to gas motor builders? Is it because the builder, having no confidence in his engine himself, is afraid to risk the criticism of others? Would any builder assert that a man who operated a motor boat should put out to sea with an engine the construction of which he was totally ignorant of, and face the possibilities of a breakdown in bad weather? This, however, is the position in which an unsuspecting buyer would find himself. The foregoing does not, of course, apply to gasoline engine builders in general, but there is more of this sort of thing in the business than is good for it. Such methods are unscientific and illiberal and savor very strongly of charlatanry. It is by the interchange of ideas and experiences that improvements are possible, and the business is of sufficient magnitude to give room for its conduct on broad lines. Mystery only increases the apprehensiveness of the many who have not got over viewing the motor boat as a sort of animated torpedo. To our readers, many of whom are interested in all that pertains to motor boats, we would say by way of caution: Do not put implicit confidence in general and vague statements of manufacturers, but insist upon knowing the why and wherefore of design and construction, and if not competent to judge yourself get some unbiased advice.

A Landsman's Trip in a Torpedo-Boat Destroyer.

I had rather a novel and interesting experience the other day, says a writer in *Chambers's Journal.*

Being in town, on sick leave from my regiment in India, with nothing to do, and lots of time to do it in, whilst eating my dinner at my club and vaguely wondering how on earth to spend that portion of the next twenty-four hours which was not night, I suddenly remembered that one of my old school-chums was in the navy, and furthermore that the last time he had written me he had mentioned that he was in command of one of the torpedo-boat destroyers belonging to the instructional flotilla at Chatham.

I hadn't his letter by me, and I was not at all certain whether it was Chatham or Sheerness, not being at all well up in things naval; but still, when I went to bed that night I registered a vow that, as time was weighing heavily upon me, the next morning I should seek for Vincent somewhere in the Medway; which vow I kept, as rising early, after breakfast I went down to Chatham, drove to the dockyard gates, and, being young and innocent, dismissed my cab.

On inquiry at the Chatham dock-gates as to whether H. M. S. Fury was in port, I had the good luck to be told, "Yes, sir; you will find her down at the South Lock. It's rather a long way, sir, and she's going out this afternoon."

Within half an hour, and after some uneasy experiences over dockyard cobbles, I came within sight of the "Fury." She certainly was not pretty; but her great length and narrow beam gave me the impression that her speed must be very great; whilst her sloping forecastle, the twelve-pounder gun on top of the fore-bridge, her other guns distributed about the deck, her torpedo tubes, and, above all, her three large funnels, filled me with the idea that she had power in her to strike, if need be, and that she would be a formidable, or at least dangerous, implement in the hands of daring officers and well-trained men.

She was painted black all over, with the exception of a white line around her just under the upper deck.

Going on board, a bluejacket, who turned out to be the quartermaster, stopped me at the gangway and asked what I wished. I gave him my card, and inquired if the captain was on board.

"Yes, sir," he said. "Please follow me."

I did so, but very gingerly, being in constant fear of tripping over valve-guards, eye-bolts, stays, etc., (these names I found out later on), with which the deck was covered, so that just as I got aft up came my old chum from below.

"Hullo, old fellow!" said he, with surprise showing all over his sunburnt face; "I never expected to see you down here. Come down below and tell me all about it."

He disappeared down the hatch, so I followed cautiously. It was just as well I did so, for at the bottom of the ladder gaped a large square hole, in the center of which was the upper half of a man's body, whom I nearly kicked.

"Oh, they're only getting up the rum," said Vincent. "Come in."

I didn't like these man-traps at all, and I told him so; but I went in, and found myself in a very cosy square room, about four yards long by six yards broad, with just room to stand upright. This was the "ward-room," and here I found the "sub" correcting some charts, and the "gunner," to both of whom Vincent introduced me.

"We're rather busy this morning," said Vincent, lighting his pipe. "We have only come up here to get a new class of stokers on board after having trained and discharged the old set; and we're going out in about ten minutes' time. You were very lucky to catch the ship at all. Look here! You had better come out for the day with us. You'll see a little of what destroyer life is like, and it will give you a bit of a blow through and an appetite. We shall land you at Sheerness afterwards, unless you care to stop for the night."

At once I acquiesced, and being left alone for a little, I had time to survey my surroundings.

Facing the door was a stove and a small sideboard, with a bookcase above, filled with books on service matters, such as channel and North Sea pilots, light lists, tide tables, etc.; a paper-rack and a wine-locker, a pipe-rack, block, chronometer-box, and one or two little nicknacks filled up that side.

On either side of me were the bunks, of which altogether there were three. These bunks, though narrow, seemed very comfortable; they were fitted with drawers underneath, and a small wardrobe was fixed at the head of each bunk. On one side, also, was a chart-box and a looking-glass, whilst behind me were lying a pile of sea-boots, and on the bulkhead were hung coats, mackintoshes, oil-skins and sou'-westers. Glancing up overhead, I saw camp-stools, swords, golf-clubs, sticks, tennis-rackets, fiddles for the tables in rough weather, etc. My friends on board knew how to pack, evidently, for not an inch of space was lost.

Having thus completed my inspection of the ward-room, I looked outside: on my left a very diminutive pantry; on my right a bath-room in like proportions, with two washing arrangements similar to those one sees in a railway carriage, and also an indiarubber bath.

Getting tired of stopping down below, and yet fearing to be in the way, I went on deck. To my surprise, I found all the men forward, and that we were quietly steaming down the Medway.

I was standing on the quarterdeck, with a six-pounder gun on a platform in front of me, which gun was reflecting the sun's rays in my eyes and dazzling me, so beautifully clean and nicely-polished was it. Behind me was a screen, sheltering the "after-steering position," fitted up, I found out later, exactly as the one forward was. There was also a hatch which led down to the captain's cabin, outside of which were store-rooms and racks for rifles and cutlasses. The cabin was a nice little place, and had a bunk, wardrobe, writing-table and bookcase, and also a little bath-room outside, but no stove. The captain in these ships messes in the ward-room, and only uses his cabin for sleeping in and for correspondence work.

Walking over the platform, I found a torpedo-tube, and alongside it a hatch, which, on inquiry, I was told led to the chief petty-officers' mess. It was quite a little place, about half the size of the ward-room. The engine-room artificers have a similar mess on the other side of the deck. Everything was beautifully clean, and the table was quite white from hard scrubbing.

Going farther forward, my olfactory organ was tickled by a most savory odor, and on looking down another hatch I found that here was the galley, and beside it stood the ship's cook hard at work getting the dinners ready. There was also here a dynamo for supplying electricity to the search-light, which latter was placed between the engine-room hatches on deck.

I now came to the engine-room, but did not go down just yet. Passing the big after-funnel, I came on an open space, and a couple of bluejackets, who were splicing a wire rope, volunteered the information that this was where the foremost torpedo-tube would be placed when the ship was used solely as a torpedo-boat. Here I was joined by the "sub," who apologized for his sudden ascent from the ward-room, and offered to show me round the rest of the ship, as the captain could not yet leave the bridge for any time.

I rather liked the rig he was in—a thick pilot coat, ditto trousers, a football-sweater, with a white silk scarf in lieu of a collar, a fairly old cap, heavy but close-fitting leather sea-boots, thick gloves, and a pair of binoculars slung round his neck, formed his

attire; which, as he went forward, I could not help thinking was, for this sort of rough-and-ready life, absolutely the best he could wear.

Between the two foremost funnels is the standard compass, with the flag-locker underneath it, and a chart-table, all of which the "sub" pointed out.

"How many men are there on board?" said I.

"Oh, our complement is fifty-two all told; but about thirty of these are stokers for training in the working of water-tube boilers, and they are changed every month. This is their mess-deck. The magazine and shell-room for the twelve-pounder are under here also."

"There's not much room for thirty, is there?" hazarded I, drawing a bow at a venture, as I felt I should say something.

"Well, no, there's not very much; but they get along all right. You see, some sling their hammocks, and the others sleep on the lockers; and if they are cold they use their duffle suit, which consists of a pair of trousers made of very thick fearnought, and a big coat of the same material with a hood attached, and it is fitted with beckets and wooden toggles for fastening and I think that chap up there would give a pretty good account of himself."

He pointed up at the gun on the fore-bridge as he spoke, and I agreed with him, and inwardly determined that any further acquaintance I might make with "that chap up there" should be made from behind, and not from in front.

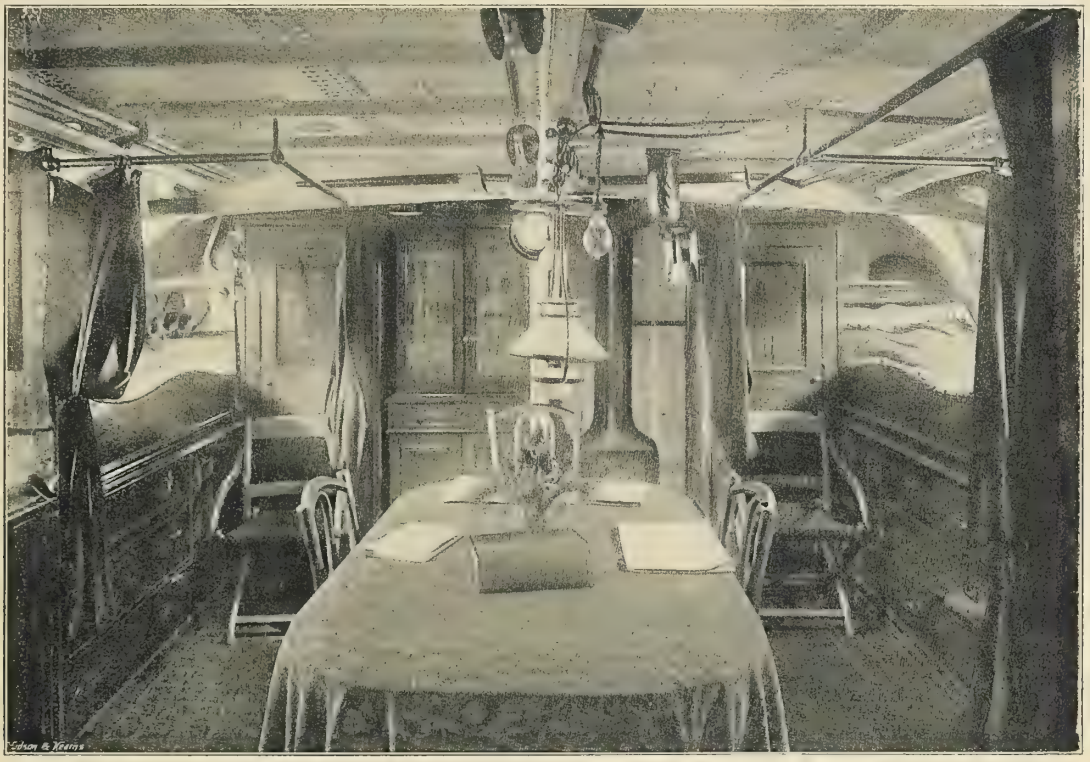
"The ship seems very long," I said; and, being rather curious on this point, I added, "What length is she?"

"Oh, about two hundred feet," he answered.

"And her beam?"

"That is about nineteen and a half feet, and she draws about six. See here; this is the conning-tower, with our half-inch of armor on it. Isn't it a lot? We can steer from here, and in bad weather we have to, as one would be washed away on the bridge."

I looked inside. There was just room for two people to stand up inside, and it was fitted with a compass, steering-wheel, telegraph to the engine-room, and voice-pipes to the torpedo-tubes and various other parts of the ship.



WARD ROOM AND OFFICERS' BERTHS ON TORPEDO-BOAT DESTROYER.
(Reproduced from the Army and Navy, London.)

it by. We (the officers) find them very useful to put on over our oilskins during a bad night's run. You can't get very wet, and they keep you as warm as toast.

"Do you know what this is?" he said, to change the subject. "It is a collapsible boat. We have two, one each side, you see. They are hoisted out by that derrick on the mast, and if we had to abandon ship they would take seventeen men each, and provisions for them as well.

"You see the deck is covered with a kind of linoleum; it is found to answer much better than wood in this class of ships, as also in torpedo-boats. Here are two six-pounder Hotchkiss guns; these and the twelve-pounder up there constitute our bow-fire. Pretty strong for so small a ship, isn't it? You see, our object is to overtake and destroy by our superior gun-fire an enemy's torpedo-boats; consequently, when chasing, bow-fire would be of great importance,

"You say this is only half-an-inch thick?" I queried. "How thick, then, is the ship's side?"

"Oh," said he, laughing, "about an eighth of an inch;" and before I could quite grasp how much an eighth of an inch of steel really is in thickness, he had disappeared down a ladder at my feet.

"Come down here," he said, looking up and smiling at my evident blank dismay at his last piece of information. "This is the mess-deck for the blue-jackets—under the turtle-backed forecastle, you see."

One long table stood in the center, and two rows of lockers ran along the ship's side. A few men were down here, one stitching canvas, another mending his clothes, one reading a book, another writing a letter, and one stretched out right forward fast asleep, utterly oblivious of everything going on beside him.

"About twenty men live down here," said the "sub." "These are their hammocks, and that is the capstan engine—we have a steam-capstan."

He pointed above his head as he spoke.

"More store-rooms under our feet, too," he continued. "We keep the explosive war-heads for the torpedoes down below here. We have two eighteen-inch torpedoes carried, without the heads, in the tubes themselves. Now let us go up on the fore-bridge."

I followed him up the little iron ladders till beside the twelve-pounder, alongside which my old chum was standing, a chart in one hand and a pair of binoculars in the other; and when I reached the top I drew a long breath.

We had increased speed, and now we were well out of the Medway, and gliding along through the water so smoothly that I could hardly believe the statement that our speed was over twenty-four miles an hour. Slipping through the water with no vibration at all, the only indications of speed were the ripples on the water flying past us, and the fountain of spray rising at our sharp, straight stem, sparkling with all the colors of the rainbow as the sun's rays flashed upon it.

Far astern is the Nore light-vessel, clearly showing up on the horizon; a little ahead is the Mouse light-ships, round which we are going.

A beautiful blue sky above, with hardly a cloud to be seen, except that on one part of the horizon there is a little haze, which does not altogether cover a number of sailing-ships, vainly trying with the little wind there is to make headway against the tide. The fountain at the bows is playing beautifully now, and all around is the pure, bright sea-air blowing against one's face, and through one's clothes, and into one's body; rousing, stimulating and reviving one, and making one feel a new man, so refreshing and exhilarating it is.

Oh! that time was splendid, and I felt glad to be alive to experience such a sensation.

No wonder these fellows look so healthy with such a tonic, and living such a life as this.

"Starboard!" sings out my friend. "Starboard, sir," answers the quartermaster, whose head I, being startled in my reverie, nearly tread on, it having come up suddenly through a hole in the platform on which we are standing.

"Well, how do you like it?" queries my chum. "'Midships; steady." "Steady, sir," replies the head.

"I wish I were in your place," said I. "You have made a new man of me already."

"Oh," replied he, laughing, "come out on a cold, wet night in January, when a heavy sea is running, and you have to hang on to the rails or the twelve-pounder here to prevent yourself being carried off your feet; when the seas rise dashing on the turtle-back, and washing all over the upper-deck; when you are soaked to the skin, and, clinging on to something, are shivering and thinking of the many thousands ashore who are fast asleep, warm and snugly tucked between the blankets; when the blinding spray and sleet is lashing your face like whipcord in an incessant shower, so that you can hardly open your eyes as you vainly struggle to peer into the darkness to discern the lights of the vessel ahead; and when everything down below in the ward-room is sliding about on the deck, gloriously mixed up, so that if you wish to get a piece of meat for supper you have to hold the joint with one hand whilst you hack off a slice with the knife, and when you can't stand up by yourself—you'd soon change your mind."

Walking aft, we went down the engine-room ladder.

"I'm sorry we are only going 280 revolutions per minute now," says he. "You should see them going at 350. That's the time."

But even as it is, I wonder mightily to see these two engines with their many bright rods flashing up and down at a speed I can hardly make my hand move at; and the cranks whirring round at the rate of four revolutions per second are alone enough to make one pause and wonder when human ingenuity will reach its limit, and also speculate on what a terrible smash there would be if anything chanced to go wrong.

"Lunch!" yells the matter-of-fact "sub" down the hatch, and again are my musings rudely interrupted.

"We'll just have time for 'scran' before we get in," he says, as we all sit down round the little table in the ward-room. "The skipper is going to have his afterwards. Aren't you hungry? I am."

To which question I had to confess a mild "Yes, very." To tell the truth, I have ever since been envious of the appetite I had that day. But to continue.

Chaffing and joking formed the conversation whilst plates were being emptied and refilled, for every one seems to be put in a good temper by this sort of work. Millionaires should buy a destroyer, and try the life as a recipe for dyspepsia.

As to the messing, I must say it was far better than I imagined could obtain on board a small boat like this.

Plain but good and substantial food, excellently cooked, is the order of the day; and cut and come again is the order of the table; which last I carried out in spirit and in truth. A knock at the door. "Come in," shouts the "sub."

"Just going into harbor, sir. Captain sent me down to tell the officers," says the signalman.

Up the others jump. I follow, and reach the deck just in time to hear the telegraph gongs sound in the engine-room as the indicators are put to "slow."

We pass up close under the stern of the battleship "Sans Pareil," the guardship here, and very shortly after reach our buoy; and then I noticed that the smartness and agility which was the peculiar characteristic of the British bluejackets in olden times has not yet passed away, for a hand is down over the side and on the buoy in a twinkling, a hook-rope is hooked on, the cable passed down by the aid of a small rope, and then quickly shackled on to the buoy, and the bluejacket is up the side and inboard, whilst the cable is paid out under the direction of the gunner on the forecastle.

I hear the dingey called away, and turning round with the "sub," who has been explaining the proceedings to me, and going aft, I find my chum in mufti waiting to take me off. As for his lunch, he will get that ashore, he says; so "chin-chins" are passed, and, stepping over the side and down the ladder, we are quickly pulled beachwards, after a day's outing which was full of novelty to me, and which will not be forgotten for some time to come.

While cruising in a fog on the night of May 28, the U. S. S. Columbia was run into by the British freight steamer Foscolia, which tore a long hole in the starboard side of the warship. There was a dense fog at the time and though both vessels were sounding their whistles neither could locate the other. The "Columbia" is said to have carried no lights, a war-time precaution. The collision occurred about eight miles southwest of Fire Island light. The bow of the "Foscolia" was crushed in, and she soon filled and sank. A large hole was made in the "Columbia's" side, aft, about the waterline, but as her watertight doors had been closed she was able to proceed with only a slight list to starboard. No lives were lost. The cruiser docked at the Navy Yard in Brooklyn, where repairs were made, and she is now at sea

A collision attended with loss of life occurred between the North German Lloyd liner Ems and the Nova Scotia three-masted schooner Gypsum Princess, on the evening of June 14. The "Ems" was westbound, and when about twenty-five miles east of Nantucket, running slow in a dense fog, she cut down the sailing vessel, which immediately sank, carrying down the captain, his wife and two children, and two of his crew. The schooner was laden with about 1,100 tons of rock plaster, consigned to Staten Island parties. The lookout on the steamer did not sight the schooner until the "Ems" was in speaking distance, too late to avoid the disaster

EDUCATIONAL.

ELECTRICITY ON BOARD SHIP, PRINCIPLES AND PRACTICE.—X.

BY WM. BAXTER, JR.

Multipolar machines can be made in an almost infinite number of forms, just as is the case with those of the two pole type. Any construction that will admit of placing the poles so that their polarity will alternate around the circle will meet the requirements; but while the variety of designs can be increased indefinitely, the great majority will be found to be defective in one way or another, so that the actual number of desirable forms is not so numerous. Of all the types that have been brought forward only a few have survived, and of these the one most generally used is that shown diagramatically in Fig. 49. The ring F together with the projections N S which form the magnet cores as well as the pole pieces, forms the field proper of the machine. This may be cast integral with the base B or may be entirely independent of it. Whether the field F and the base are made in one piece or not

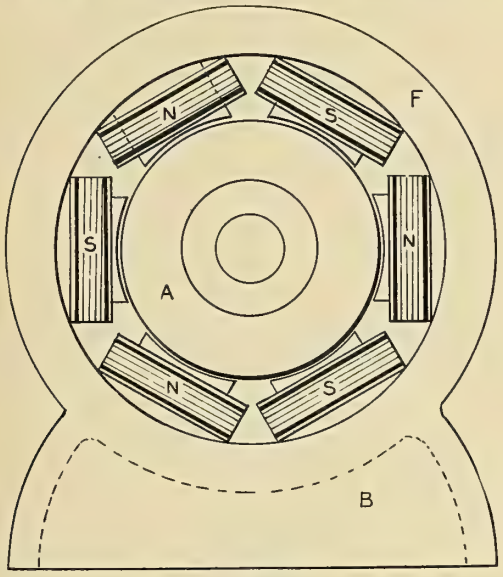


FIG. 49.

depends, in most cases, upon the facilities of the manufacturer for handling heavy work. If the tools and hoisting apparatus are small the separate construction will be followed; but occasionally this course is pursued so that the same machine may be made to run direct connected to a steam engine, or as a belted generator. If it is to be of the direct type, it is mounted directly upon an extension of the engine bed, and if it is to be of the belted type, it is placed upon the bed B, this being provided with suitable bearings to carry the shaft. These bearings, as well as the commutator and other parts, are not shown in the figure, nor in any of those that follow it, as the object of these illustrations is simply to show the relative position of the field magnets and the armature, which latter is indicated by the circle A. By comparing this figure with the two and four pole diagrams of the last article it will be seen that the construction is decidedly more massive, and preserves the compact appearance characteristic of the two pole machine.

The type of machine shown in Fig. 50, is simply an inversion of that in Fig. 49, that is, the field magnets are placed within the armature instead of outside of it. The ring A represents the armature, and the center part marked F serves the same purpose as the ring F in Fig. 49. It forms the connecting yoke between the ends of the magnet cores. In machines of this kind the base B and the part F are generally cast in one piece, except when the size is very great. When used in direct connection with a steam engine, the armature A may take the place of the fly wheel, the center F being secured to the engine bed. An objection to this design is that the armature is not protected from injury as well as in the opposite type shown in Fig. 49. In the latter the armature is within the field, and therefore if any object should fall upon the machine it would not be very likely to do any harm, whereas with the exposed armature it might work serious injury.

In both these designs it is necessary to have as many field coils as there are magnetic circuits. In some cases the number is reduced to one-half those shown in the figures, that is, three for a six pole machine, four for an eight pole, etc., but this instead of being a gain is a loss, as when one coil is used for each circuit, instead of two, the number of turns of wire in it must be equal to those in the two coils it replaces; and as on this account the outer layers of the coils become longer the total length of wire is actually increased. It is possible, however, to so

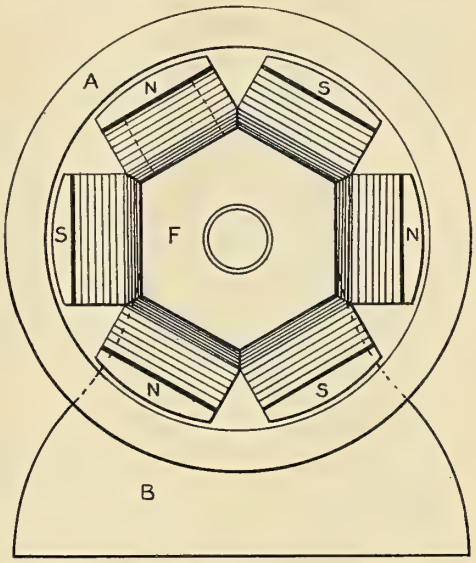


FIG. 50.

construct a machine that one coil will serve to magnetize the whole field, and when this is done the total length of wire can be considerably reduced. A design of this type is shown in Fig. 51 and 52. The first figure is a front view, and the second a half section parallel with the shaft. The magnetizing coil is shown at C, and the field magnets at N S. As can be seen from Fig. 52, the poles N of the part that passes in front of the coil C extend over the top of the latter to the oposite side of the armature A. In the same way the S poles extend forward over the coil. The part carrying the N poles is made separate from the hub F as can be seen in Fig. 52. If this were not done it would be impossible to get the coil C in place. In the section of the armature ring shown in Fig. 52, the wire is not shown, or rather wire and core are sectioned alike. It is to be understood, however, that the armature is covered with wire, but is not so shown, as it would only serve to confuse the diagram. The armature A is fastened to the shaft S by a spider which would be located on the side of the N poles.

This machine, like that shown in Fig. 50, has the field inside of the armature, but the order can be reversed so as to correspond with Fig. 49. This latter

construction is not often followed as it would largely, if not entirely defeat the object of the design, which is to reduce the amount of wire in the field coils by using only one. When the field is placed within the armature, this coil can be made of comparatively small diameter, as can be seen from the diagram; but if the armature is placed in the center, then the

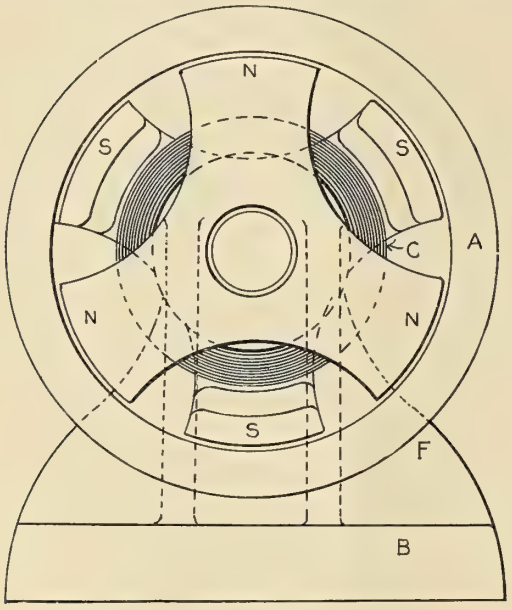


Fig. 51.

coil will have to be very much larger, and consequently the length of each turn of wire will be so much greater than the turns of coils, such as are required for the designs Figs. 49 and 50, that it will be sufficient to offset the difference in number of turns, and possibly more than offset it. Unless a considerable saving in wire can be effected by this design it is not worth using, as it cannot be made as symmetrical as Fig. 49. With the field inside the armature, as shown in the diagram, the saving in wire is sufficient to render the construction desirable, and in this form it is used to a limited extent.

Figs. 53 and 54 are a side and an end view of a design which is well adapted to cases where it is desired to reduce the width of the machine. The poles as will be noticed are placed around the outside of the armature, just as in Fig. 49, but the coils instead

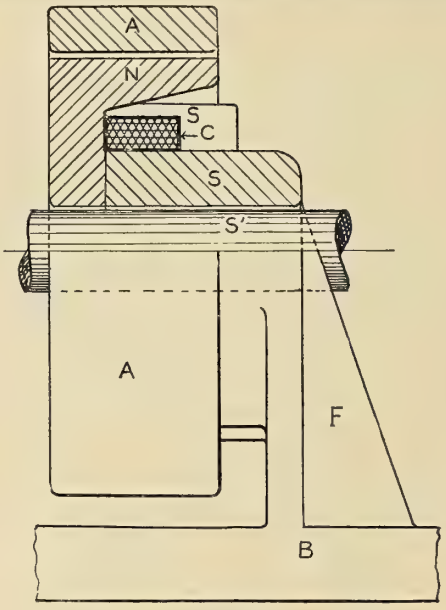


Fig. 52.

of being in the radial position, are at one side of the armature with their axis parallel with the shaft. The connecting yoke F instead of being a ring is a flat disc.

The width of this machine from outside to outside of the magnet coils is much less, relative to the

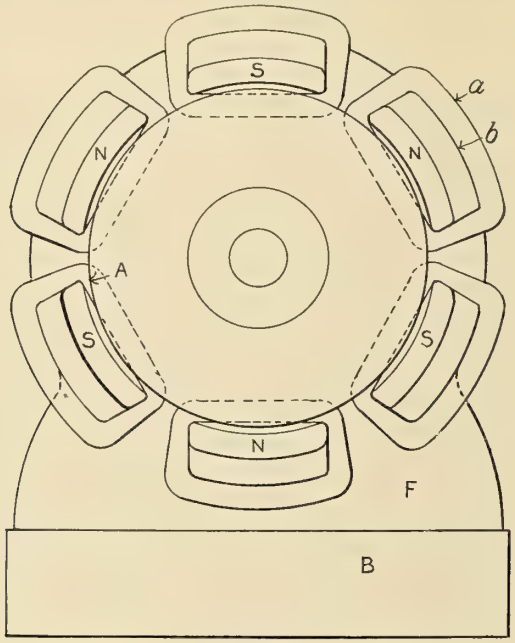


Fig. 53.

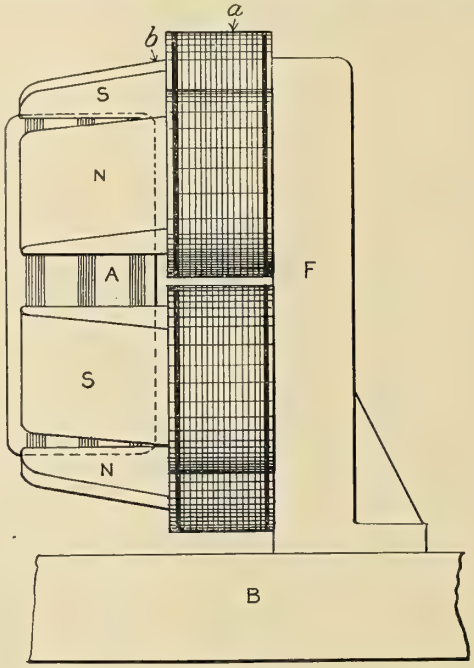


Fig. 54.

diameter of the armature, than is the case in the design Fig. 49, as can be seen from a comparison of two figures, hence, it is well adapted to cases where room in a direction transverse to the shaft is limited,

as for example where the machine is placed in a narrow passage way, or where there is very little head room. It might appear that Figs. 50 and 51 would be still more advantageous in this respect, as the field is wholly within the armature, but with these designs, it is necessary to make the armature extra large to secure sufficient room within it for the field magnets, so that for a given capacity its transverse dimension is little if any less than that of Fig. 49.

Fig. 51 is also made with the poles coming from one side as in Fig. 54, but in most such modifications the N poles are placed around the outside of the armature, and the S poles inside. This arrangement simplifies the construction, and considerably reduces the length of the machine.

The best known machine of type Fig. 50 is the Siemens and Halske. Type Fig. 51 is made by the Sturtevant Co., and type Fig. 53 by the C. & C. Co.

In summing up the merits of these different designs it may be said that, as with the two pole machines, the shape has very little to do with the efficiency, this depending almost entirely upon the relative proportions of the various parts, therefore a skilful designer can produce just as good results with one type as with another, and in making a selection will be guided principally by the conditions to be fulfilled.

ENGINEERS' DICTIONARY—VII.

Bolt.—In general a round rod or bar of metal provided with a *head* at one end and fitted with a *screw-thread* and corresponding *nut* at the other. This gives the typical *through-bolt*, Fig. 14. In some cases the bolt is threaded at both ends, or if short is threaded along its entire length, and the head is replaced by a nut. The *stud-bolt*, Fig. 15, is threaded at both ends, one end screwing into one of the portions of metal to be connected, and the other portion being provided with a hole corresponding to the body of the bolt. Such bolts are used for securing cylinder heads to the cylinders, valve chest covers to their chests, follower rings to their pistons, etc. The *cap-bolt* or *cap-screw* is a headed bolt without a nut. This form of bolt is much used for securing together two or more pieces where one of them may be readily tapped and thus made to serve as a nut, or where the use of a regular through-bolt with nut is not thought necessary.

Holding down bolts are those used to secure a structure or machine to its foundation. In particular this term refers to the bolts used to secure the engine bed-plate to its foundation. An *eye-bolt*, as shown in Fig. 16, is a bolt temporarily screwed into a convenient hole, say in a cylinder cover, and used to attach lifting and handling gear. A *forcing bolt* or *jack screw* is any form of bolt used to force apart two pieces as in breaking the joint between the cylinder head and cylinder. In such case the hole for the forcing bolt is tapped through the head only, and the bolt is screwed down through and against the cylinder flange. This results in forcing the two apart. For *stay bolt* or *screw stay* see *boiler*. In the following table will be found the U. S. standard proportions for bolts and nuts:

U. S. OR SELLERS' SYSTEM OF SCREW-THREADS.

BOLTS AND THREADS.						HEX. NUTS AND HEADS.					
Diam. of Bolt.	Threads per Inch.	Diam. of Root of Thread.	Width of Flat.	Area of Bolt Body in Sq. Inches.	Area at Root of Thread in Sq. Inches.	Short Diam., Rough.	Short Diam., Finish.	Long Diam., Rough.	Thickness, Rough.	Thickness, Finish.	Long Diam. Sq. Nuts, Rough.
Ins.		Ins.	Ins.			Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1/4	20	.185	.0062	.049	.027	1/2	7-16	37-64	1/4	3-16	7-10
5-16	18	.240	.0074	.077	.045	19-32	17-32	11-16	5-16	1/4	10-12
3/8	16	.294	.0078	.110	.068	11-16	5/8	51-64	3/8	5-16	63-64
7-16	14	.344	.0089	.150	.093	25-32	23-32	9-10	7-16	3/8	1 7-64
1/2	13	.400	.0096	.196	.126	7/8	13-16	1	1/2	7-16	1 15-64
9-16	12	.454	.0104	.249	.162	31-32	29-32	1 1/8	9-16	1/2	1 23-64
5/8	11	.507	.0113	.307	.202	1 1-16	1	1 7-32	5/8	9-16	1 1/2
3/4	10	.620	.0125	.442	.302	1 1/4	1 3-16	1 7-16	3/4	11-16	1 49-64
7/8	9	.731	.0138	.601	.420	1 7-16	1 3/8	1 21-32	7/8	13-16	2 1-32
1	8	.837	.0156	.785	.550	1 5/8	1 9-16	1 7/8	1	15-16	2 19-64
1 1/8	7	.940	.0178	.994	.694	1 13-16	1 3/4	2 3-32	1 1/8	1 1-16	2 9-16
1 1/4	7	1.065	.0178	1.227	.893	2	1 15-16	2 5-1-	1 1/4	1 3-16	2 53-64
1 3/8	6	1.160	.0208	1.485	1.057	2 3-16	2 1/8	2 17-32	1 3/8	1 5-16	3 3-32
1 1/2	6	1.284	.0208	1.767	1.295	2 3/8	2 5-16	2 3/4	1 1/2	1 7-16	3 23-64
1 5/8	5 1/2	1.389	.0227	2.074	1.515	2 9-16	2 1/2	2 31-32	1 5/8	1 9-16	3 5/8
1 3/4	5	1.491	.0250	2.405	1.746	2 3/4	2 11-16	3 3-16	1 3/4	1 11-16	3 57-64
1 7/8	5	1.616	.0250	2.761	2.051	2 15-16	2 7/8	3 13-32	1 7/8	1 13-16	4 5-32
2	4 1/2	1.712	.0277	3.142	2.302	3 1/8	3 1-16	3 5/8	2	1 15-16	4 27-64
2 1/4	4 1/2	1.962	.0277	3.976	3.023	3 1/2	3 7-16	4 1-16	2 1/4	2 3-16	4 61-64
2 1/2	4	2.176	.0312	4.909	3.719	3 7/8	3 13-16	4 1/2	2 1/2	2 7-16	5 31-64
2 3/4	4	2.426	.0312	5.940	4.620	4 1/4	4 3-16	4 29-32	2 3/4	2 11-16	6
3	3 1/2	2.629	.0357	7.069	5.428	4 5/8	4 9- 6	5 3/4	3	2 15-16	6 17-32
3 1/4	3 1/2	2.879	.0357	8.296	6.510	5	4 15-16	5 13-16	3 1/4	3 3-16	7 1-16
3 1/2	3 1/4	3.100	.0384	9.621	7.548	5 3/8	5 5-16	6 7-64	3 1/2	3 7-16	7 39-64
3 3/4	3	3.317	.0413	11.045	8.641	5 1/4	5 11-16	6 21-32	3 3/4	3 11-16	8 1/8
4	3	3.567	.0413	12.566	9.963	6 1/8	6 1-16	7 3-32	4	3 15-16	8 41-64
4 1/4	2 7/8	3.798	.0435	14.186	11.329	6 3/8	6 7-16	7 9-16	4 1/4	4 3-16	9 3 16
4 1/2	2 3/4	4.028	.0454	15.904	12.753	6 7/8	6 13-16	7 31-32	4 1/2	4 7-16	9 3/4
4 3/4	2 5/8	4.256	.0476	17.721	14.226	7 1/4	7 3-16	8 13-32	4 3/4	4 11-16	10 1/4
5	2 1/2	4.480	.0500	19.635	15.763	7 5/8	7 9-16	8 27-32	5	4 15-16	10 49-64
5 1/4	2 1/2	4.730	.0500	21.648	17.572	8	7 15-16	9 9-32	5 1/4	5 3-16	11 23-64
5 1/2	2 3/8	4.953	.0526	23.758	19.267	8 3/8	8 5-16	9 23-32	5 1/2	5 7-16	11 7/8
5 3/4	2 3/8	5.203	.0526	25.967	21.262	8 3/4	8 11-16	10 5-32	5 3/4	5 11-16	12 3/8
6	2 1/4	5.423	.0555	28.274	23.098	9 1/8	9 1-16	10 19-32	6	5 15-16	12 15-16

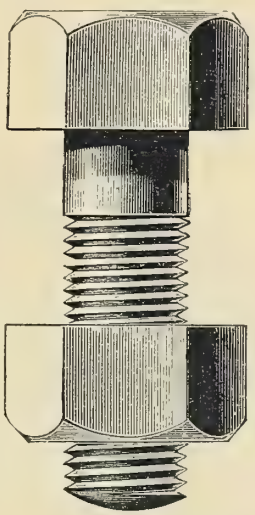


Fig. 14.

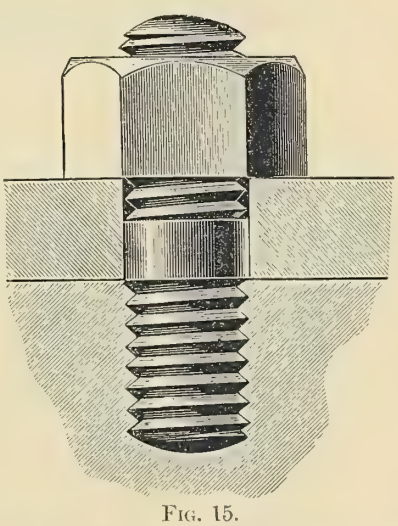


Fig. 15.

For the *locking* of bolts and nuts, various devices are used. Under continuous jar, screwed connections are liable to gradually work loose and thus nuts

might come off or stud bolts come out, and serious damage result. A very common form of lock is the double or jam-nut arrangement shown in Fig. 17. One nut being screwed down hard against the other, the surfaces of the nut and bolt become forced together in opposite directions in the two nuts, and thus no matter what the jar or change in the bolt, the two sets of surfaces continue to be firmly forced together, and no opportunity of working loose is presented. Another very common form is the *split-pin*, as shown in Fig. 18. A hole is drilled through the bolt just over the nut and a pin formed of a piece of soft steel wire bent on itself is inserted. The ends are then opened out and the nut is securely locked. The split-pin, however, cannot prevent the nut from backing off slightly, and the amount of possible movement will become greater as wear occurs and the nut is screwed further down. This can be compensated for by the use of a washer between pin and nut, but in any case the split-pin must be considered as a lock against the loss of the nut rather than against the slight loosening. A modification securing the nut against even

Fig. 16.

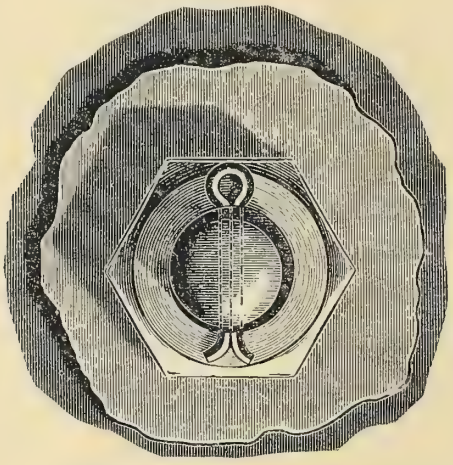


Fig. 18.

an initial loosening is frequently fitted. To this end scores or grooves are cut in the top of the nut, and the hole in the bolt is so placed that the pin rests partly in the these scores. These being several in number the pin can be inserted in any one of a corresponding number of positions of the nut. This form of lock is absolute and perfectly reliable, but is evidently of use only in cases where little or no wear and readjustment is expected. Nuts are often secured by set-screws in various ways. In some cases the set-screw bears directly on the thread, but this is not good practice, as the thread is likely to be injured and the removal of the nut is rendered difficult. In other cases a plug with screw thread or of soft metal is inserted to bear on the thread of the bolt, and is forced down by a set-screw. In other cases the upper part of the bolt is turned down clear of the thread and the set-screw bears on this portion. In other cases, where the form of the pieces allows, the nut is secured by a set-screw bearing on a part of the nut turned down and entering a recess or counterbore formed in the piece on which it bears, as shown in Fig. 19. In other forms, locking plates or strips are used. In Fig. 20 a plate fitting the nut is secured to the piece on which the latter rests, and this prevents the nut from turning. The plate, as shown, is so notched as to fit the nut in any one of twelve positions. In Fig. 21 the plate is fitted with a slot in such way that the plate and nut can be fitted in any position of the latter. In all cases where set screws are thus used, it will be noted that unless some means of locking them is provided, they may work loose and thus allow the main locking device to become inoperative or worthless. Set screws are often locked by a slight deformation or jamming of their thread by means of punch or chisel. This being effected at the point where the screw enters its thread, the unscrewing due to jarring may be prevented,

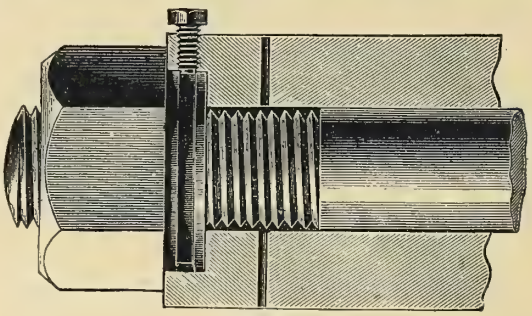


Fig. 19.

while the jamming is not sufficient to prevent removal by means of a wrench. This, of course, is bad engineering. By a slightly different arrangement of the elements of Fig. 21, the locking may be made complete instead of dependent upon a second screw. The screw in this case is in the form of a stud-bolt with square body fitting the slot in the plate. Above this is a thread upon which is screwed the nut which holds the plate in place. This nut is in turn secured by a plit-pin. Thus the plate locks the large nut, the stud-bolt and small nut secure the plate, the square body and slot lock the stud-bolt, and the pin locks the small nut. All screwed fastenings on marine engines, especially those on the moving parts, should be fitted with some efficient form of locking device. This is more necessary than in land practice where

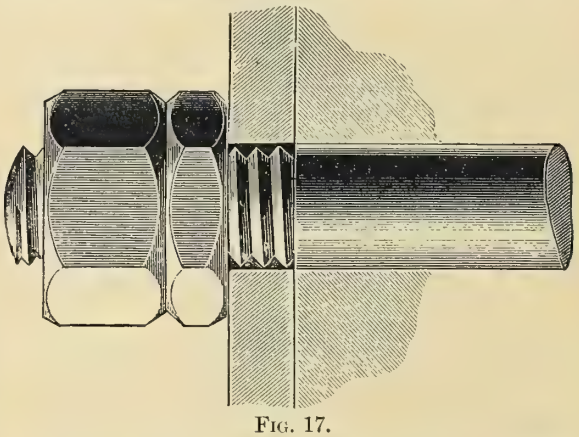


Fig. 17.

engines are usually shut down every day, allowing opportunity for inspection of parts, while in marine practice continuous runs of a month or more are frequent.

At the annual meeting of the Maritime Association of the Port of New York, President Hugh Kelly reported that the organization at the beginning of the year had 1,125 members and at the close 1,097; nineteen members had died during the year 1897.

QUERIES AND ANSWERS.

Q.—Please give a method for determining the sizes of the cylinders for a quadruple expansion engine, the steam pressure being, say, 200 lbs. per sq. in. Also, what you would consider the best points of cut-off for the different cylinders. STUDENT.

A.—For convenience we may divide the work up into a series of steps as follows:

(1) Assume the total number of expansions which the engine is to give. This is usually from 8 to 12 for triple expansion engines, and 10 to 15 for quadruple expansion. Within these limits, the greater the number of expansions the more economical will the engine be in coal consumption, but at the same

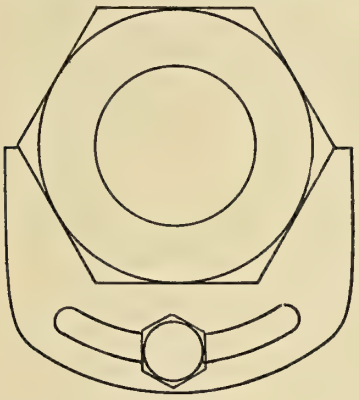


FIG. 21.

time the larger and heavier will it result. The number of total expansions selected will therefore depend on the relative importance placed on economy in coal consumption and economy in weight and space occupied.

(2) Find the absolute pressure at the high pressure valve chest by adding 15 lbs. to the gauge pressure at this point, making due allowance for the drop in pressure between boiler and engine. Then multiply this absolute pressure by the factor a in Table I below.

(3) From this result, which is an ideal mean forward pressure, subtract the assumed mean back pressure in the low pressure cylinder, which may usually be taken at from 3 to 4 lbs.

(4) If there were no loss between the ideal and the actual this would be the mean effective pressure, assuming all the

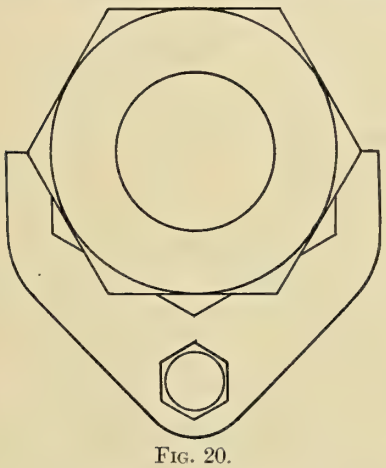


FIG. 20.

expansion to take place in a single cylinder. Assume next a card factor; that is, a factor which is intended to express the fraction of this ideal which is obtained in the actual case. This factor is usually about .60 to .70 with triple expansion engines, and a little less, perhaps from .55 to .65, with quadruple expansion. Multiply the result in (3) by this factor and call the product p. This result p is the probable or expected mean effective pressure reduced to the L. P. piston, and it should be remembered that it is at this point that the design is connected with actual experience.

(5) Next select a piston speed at which it is desired to run. This may vary from 500 to 1,000 feet per minute or upward, depending on the special conditions. Any limitations affecting the number of revolutions may also affect this speed. At this point, however, a trial value must be taken, and the design carried through on this basis. Denote the value assumed by S, and the I. H. P. by H.

Then substitute the known values in the formula:

$$A = \frac{33000\ H}{p\ S}$$

The result A will be the area of the L. P. cylinder in square inches. We may also denote these operations by rule as follows:

RULE: Multiply the I. H. P. by 33,000, and the pressure p as determined in (4) by the piston speed assumed. Then divide the former product by the latter. The result will be the area of the L. P. cylinder in square inches.

(6) Select from Table I the area ratios corresponding to the total number of expansions, and divide the area found in (5) by them. The results will give appropriate areas for the other cylinders, assuming a cut-off of about .60 in the H. P. cyl-

TABLE I.*

Total Number of Expansions.	Factor a.	Triple Expansion. $\frac{A_3}{A_2}$	Triple Expansion. $\frac{A_3}{A_1}$	Quadruple Expansion. $\frac{A_4}{A_3}$	Quadruple Expansion. $\frac{A_4}{A_2}$	Quadruple Expansion. $\frac{A_4}{A_1}$
7	.421	2.19	4.38	1.73	2.81	4.38
8	.385	2.35	5.00	1.80	3.07	5.00
9	.355	2.49	5.63	1.87	3.32	5.63
10	.330	2.62	6.25	1.93	3.56	6.25
11	.309	2.75	6.88	2.00	3.79	6.88
12	.290	2.88	7.50	2.06	4.02	7.50
13	.274	2.99	8.13	2.11	4.24	8.13
14	.260	3.11	8.75	2.16	4.46	8.75
15	.247	3.21	9.38	2.22	4.66	9.38

inder. This may be taken as an appropriate point of cut-off for the H. P. cylinder with the usual form of marine valve gear. For the remaining cylinders the cut-off is usually a little later, say from .65 to .75. It will be remembered that the cut-off on these remaining cylinders exercises no direct effect on the *amount* of power developed. It affects simply its distribution among the cylinders.

The areas of the cylinders being thus determined, their diameters follow immediately, most conveniently from a hand book giving diameters and areas of circles. The length of stroke may then be taken, usually not far from two-thirds the L. P. diameter, or frequently about the same as the I. P. diameter in a triple expansion engine. The stroke being taken, the revolutions follow immediately by dividing the assumed piston speed by twice the stroke in feet, or in symbols:

$$N = S \div 2\ L.$$

Examples:

(1) For a triple expansion engine of 1,000 I. H. P., take steam at the engine at 175 lbs. gauge, or 190 lbs. absolute. Assume 10 for the total number of expansions.

Then from the table, $a = .33$

Then $.33 \times 190 = 62.7$

Take back pressure $= 3.$

Remainder $= 59.7$

Take card factor $= .65$

Then reduced mean effective pressure $= 59.7 \times .65 = 38.8$

Take piston speed $= 800.$

$$\text{Then } A_3 = \frac{33000 \times 1000}{38.8 \times 800} = 1063$$

Then from Table I $A_2 = 1063 \div 2.62 = 406$

and $A_1 = 1063 \div 6.25 = 170$

Then finding the diameters, we have the following:

$D_3 = 36\ 3\text{-}4$

$D_2 = 22\ 3\text{-}4$

$D_1 = 14\ 3\text{-}4$

A suitable stroke would be either 21 in. or 24 in. This would give for the revolutions per mt.:

$$N = \frac{800}{3.5} \text{ or } \frac{800}{4}$$

or $N = 229$ or 200

(2) For a quadruple expansion engine of 1,000 I. H. P., take steam at the engine at 200 lbs. gauge, or 215 lbs. absolute. Assume 12 for the total number of expansions. Then from the table, $a = .29$.

Then $.29 \times 215 = 62.35$

Take back pressure $= 3.00$

Remainder $= 59.35$

Take card factor $= .58$

Then reduced mean effective pressure $= 59.35 \times .58 = 34.4.$

Take piston speed $= 800$

*Note.—A_1, A_2, A_3 denote the areas of the cylinders of a triple expansion engine, beginning with the H. P. Similarly, A_1, A_2, A_3, A_4, denote the areas of the cylinders of a quadruple expansion engine.

$$\text{Then } A_4 = \frac{33000 \times 1000}{34.4 \times 800} = 1199$$

Then from Table I $A_3 = 1199 \div 2.06 = 582$
$A_2 = 1199 \div 4.02 = 298$
$A_1 = 1199 \div 7.50 = 160$

The corresponding diameters are:

D_4	=	39
D_3	=	27 1-4
D_2	=	19 1-2
D_1	=	14 1-2

The stroke might be taken about 24 in. or 2 ft., which would give, correspondingly, revolutions about 200 per mt.

Q.—What is the formula for determining the thickness of a cast steel dished piston, that is now mostly used in marine engines that have lately been built?

S.

A.—The thickness of dished steel pistons for triple and quadruple expansion engines may be computed by means of the following formulae. These formulae are empirical in their nature. That is, they are so constructed as to relate the thickness of the pistons to the quantities on which they should depend, and the numerical portions are then determined from experience, so that, finally, the formulae are to be considered simply as convenient ways of expressing the results of safe and standard practice. For the various cylinders we have then as follows for the thickness near the boss:

$$T_H = .22\sqrt{\frac{H\,D}{S}} + .30 \qquad (1)$$

$$T_I = .22\sqrt{\frac{H\,D}{S}} + .50 \qquad (2)$$

$$T_L = .18\sqrt{\frac{H\,D}{S}} + .70 \qquad (3)$$

Where the letters have the following significance:

T_H, T_I, and T_L = thickness near boss, respectively, of the high, intermediate and low pressure pistons.
H = indicated horse power to be developed in the given cylinder.
D = diameter of the given cylinder in inches.
S = piston speed in feet per mt.

For the thickness near the edge we may use the following proportions:

H. P. Thickness near edge = .65 thickness near boss.
I. P. " " " = .60 " " "
L. P. " " " = .55 " " "

For quadruple expansion engines the thickness of both intermediate cylinders may be determined by the use of formula (2).

Example: Let I. H. P. of engine = 1,600.

Let the cylinders be 20 in., 31 in. and 49 in. by 36 in. stroke, and let the revolutions be 125 per mt. Then S = 750. Then assuming the power about equally divided between the cylinders, we have in each case H = 533.

Hence:

$$T_H = .22\sqrt{\frac{533}{750} \times 20} + .3 = .83 + .30 = 1.13 \text{ or } 1\tfrac{1}{8} \text{ in.}$$

$$T_I = .20\sqrt{\frac{533}{750} \times 31} + .5 = .94 + .50 = 1.44 \text{ or } 1\tfrac{7}{16} \text{ in.}$$

$$T_L = .18\sqrt{\frac{533}{750} \times 49} + .7 = 1.06 + .70 = 1.76 \text{ or } 1\tfrac{3}{4} \text{ in.}$$

For the thickness near the edge we should have respectively: 3-4 in., 7-8 in. and 1 in.

Q. How do you go to work to set the blades on a ship with twin screws? I know how to do it with one screw, but the two wheels bother me. Where do you take your line for the angle?

J. W. B.

A.—The method of adjusting the blades of the propellers for twin screws is in every way similar to that for a single screw. The principle to be borne in mind is that each propeller is referred to its own shaft, and the plane with reference to which the pitch is set is in each case at right angles to the shaft axis. Hence with shafts diverging, as is usually the case, these reference planes are not exactly transverse or at right angles to the keel line. It results that the real pitch relative to the direction of motion is not quite equal to that for which the blades are set, but varies during a revolution slightly above and below this as a mean value. The variation, however, is not large, and is usually neglected in considering the pitch of the propellers.

As other readers may be interested in this general question, a brief description of the method of adjusting propeller blades is added. The principles involved are precisely the same as for measuring the pitch of a propeller as described in Marine Engineering for March, p. 36, and to which reference should be made. Fig. 1 is here reproduced from that account and will serve to illustrate the present answer, though in the case there assumed the blades for convenience were taken as fixed. The screw being in position on the shaft the arms P Q and P R which determine a reference plane at right angles to the shaft axis may be provided most conveniently by an arm and hub of wood fitted to the projecting end of the shaft, the nut being removed for the purpose. The wooden hub should be made in two parts with provision for clamping so that it may be fixed in any desired position, and it may be well to bush it with sheet metal in order to prevent its following the threads. It should be faced and fitted snugly up to the after face of the propeller hub so that when it is turned around there will be no fore and aft motion. A stiff wooden arm carried on the hub then completes the apparatus and serves,

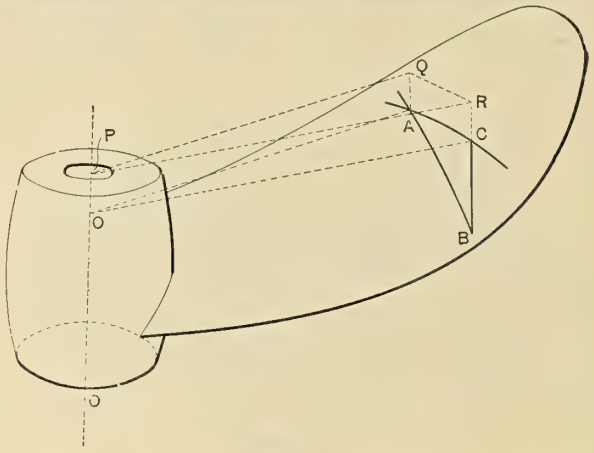


FIG. 1.

as it is turned about the shaft, to determine a reference plane or edge from which the necessary measurements can be made.

In proceeding with the adjustment a blade may be set by judgment and the resulting pitch measured. The setting may then be corrected until by successive trials the pitch is brought to the desired value. If the propeller is a true screw or of uniform pitch for some one adjustment, it will no longer remain so when the blades are twisted, and measurements at different distances from the hub will give slightly different values for the pitch. If measurements are not made at more than one location, it should be at about two-thirds the length of the blade from the hub. If the mean of two sets of measurements is taken, they may be located at about the middle of the blade and at about three-quarters the length from the hub. We may determine more rapidly the adjustment corresponding to any given value of the pitch at any given location as follows. Referring to the drawing we have, as explained in the March number, the following proportion:

A C : $6.2832 \times$ O A :: B C : pitch;

$$\text{or B C} = \frac{\text{A C} \times \text{pitch}}{6.2832 \times \text{O A}};$$

$$\text{or B C} = \frac{\text{pitch} \times \sqrt{\overline{\text{A B}}^2 - \overline{\text{B C}}^2}}{6.2832 \times \text{O A}}$$

From this we find on solving for B C,

$$\text{B C} = \frac{\text{pitch} \times \text{A B}}{\sqrt{(\text{pitch})^2 + 39.48\ \overline{\text{O A}}^2}}$$

This gives by formula the difference B C between the distances R B and Q A from the reference line to the surface of the blade at the given points A and B. These operations may be expressed by a rule as follows:

(1) Take the given radius as O A in the diagram.
(2) Select two points at this radius as A and B and measure A B.
(3) Multiply the desired pitch by the distance A B.
(4) Add the square of the pitch and 39.48 times the square of O A and take the square root of the sum.
(5) Divide the product obtained in (3) by this square root and the quotient will be the distance B C suitable for the desired pitch at this radius. The blade must then be so adjusted as to make the measurement B C conform to this value.

According to reports in the press there is a prospect that another shipyard will be established at Portland, Ore., by Chicago capitalists. The site said to have been selected has a depth at low water of about 26 ft. at the launching ways.

The Cleveland Ship Building Co., is reported to have secured a contract for a new steamer for the Northern Steamship Co., in dimensions about 400 ft. long, 50 ft. beam, and 28 ft. deep, to cost in the neighborhood of $240,000.

OBITUARY.

Niven C. Mehan died at Rockland, Me., June 12, from a stroke of apoplexy. He learned the shipbuilding art in New England, and in the early fifties was established in Rockland. Later he came to New York to the yard of William H. Webb, and thereafter was associated with Charles Payson at Thomaston, and Samuel Watts at Boston.

Thomas Mudd, an eminent English engineer, died at his residence in Hartlepool, May 17. He was managing director of the Central Engine Works at West Hartlepool, where he designed and built the famous machinery equipment of the freight steamer "Inchmona," described in our issue of February last. Deceased was a member of various British engineering societies and had been prominent in municipal affairs, having been twice mayor of Hartlepool.

John F. Pankhurst, vice-president and general manager of the Globe Iron Works Co., died in Cleveland June 2. This was his native city, he having been born there in 1838. When a lad at school he decided upon marine engineering as his life work and pursued studies with this in view and later served his apprenticeship as a machinist. When this was completed he spent some time as an engineer on the lakes. In 1865 he went into business with Mr. Wallace, and later the Globe Iron Works was taken over by the concern. In 1886 the works ownership was reorganized and incorporated with a capital stock of half a million dollars. In this corporation Mr. Pankhurst was given the position he held until his death.

Samuel Plimsoll, universally known in shipping circles as the "sailors' friend," died in England early last month, aged 74 years. Every British vessel carries a reminder of his great sympathy for those exposed to the perils of the sea, in the load waterline or Plimsoll mark painted on the side. He was a native of Bristol and from his earliest days took an active interest in shipping affairs. Finding that he could do more for the sailor in the British Parliament than outside he contested the Derby seat in the Liberal interest in 1868, and for many years thereafter was a familiar figure in the House of Commons. He met with tremendous opposition, but his exposure of the rascally doings of British shipowners, some of whom were in Parliament at the time, compelled the passage of laws which did away with the "floating coffins"—vessels in rotten condition, overloaded with cargo and insurance, and undermanned, which left port and never returned.

Dr. Charles E. Emery died of heart disease at his residence, 370 Gates avenue, Brooklyn, June 1. He was born in Aurora, N. Y., in 1838, and in 1861 he entered the navy and was commissioned third assistant engineer of the "Richmond," seeing a good deal of active service before the close of the war. In 1867 he retired from the navy and became consulting engineer for the U. S. Coast Survey and Revenue Service. Later he occupied himself almost exclusively with engineering matters on land, including the installation of the system of the New York Steam Company. He retained, however, an active interest in marine construction and was regularly at the meetings of the Society of Naval Architects and Marine Engineers, of which he was a member. Several of the leading technical societies bear his name on their rolls. Dr. Emery's reputation was international, he having, among other achievements, secured the Telford prize from the British Institution of Civil Engineers for an original paper. Due to his large frame he was always a noticeable figure at scientific gatherings, and his genial personality will long be pleasantly remembered by a large circle of friends. He leaves a widow and one son.

BOOK NOTICES.

"Practical Advice for Marine Engineers," by Charles W. Roberts, M.I.M.E., is contained in a 150-page book published by Whittaker & Co., Paternoster square, London. It is entirely practical in character, giving hints on matters about which questions arise every day in the engine room. There are six chapters entitled: The Engineer; In the Stokehold; The Donkey Boiler; In the Engine Room; Down the Tunnel, and The Propeller. Many easily understandable engravings are used where they do the most good, and altogether it is an excellent little work. The selling price is 2s 6d a copy.

The Scientific American Special Naval Supplement recently issued includes a brief history of the navy between the years 1883-1898, with the authorizations up to date. The method of classifying the various types of war vessels is explained and a full description is given of all the principle war vessels under the following main heads: Battleships, Cruisers, Monitors, Gunboats, Torpedo Boats, etc. Valuable tables of statistics are also given, and a colored map of Cuba. The number is filled with fine engravings of vessels of the Navy, and the text is written in a very readable and popular style. Copies can be had by mailing 25 cents to the publishers, Munn & Co., 361 Broadway, New York.

"Refrigerating Machinery, its Principles and Management," is the title of a little book received from the author, A. Ritchie Leask, of London, England, which is a practical treatise on the subject. It was written to cover the methods of refrigeration now in vogue rather than to explain any special application of the systems ashore or afloat. It is of convenient size and covers the subject very concisely and clearly, though, of course, from a British standpoint of view. The introductory chapter is chiefly historical, but also states clearly the laws of physics involved in the construction of such machines. This is carried in the next chapter into a discussion of the various systems of producing ice. Then follow in order, chapters on ammonia and cold air machines, comparisons of the different systems and their applications, and lastly a chapter of practical hints upon the operation and regulation of machines and consideration of questions of efficiency and cost. The book is a convenient size for desk use and contains a large number of excellent illustrations. The American agents for this work are Spon & Chamberlain, 12 Cortlandt street, New York.

"Naval Engineers and the Command of the Sea," by Francis G. Burton, which appeared in serial form in the Practical Engineer, England, has been reprinted in book form by the Technical Publishing Co., 31 Whitworth street, Manchester. This book is really 230 pages of glorification of the British Navy with corresponding disparagement of other navies including the French and United States. The title is scholarly, the book anemious. Instead of concentrating interest upon a logical discussion of the subject the author wearies his reader with interminable discussions of side issues. To make these palatable he works in a lot of narrative about imaginary sea fights in which the French fleet finally meets with disaster, in a war with that nation, and the United States having turned pirate is equally subdued. "There was much tall talk in Washington of a dash on Canada," says the author, "whilst the drinking saloons of New York, Chicago and Baltimore were rife with suggestions for the destruction of the British power, but no concerted military or naval movements resulted therefrom." It will be noticed how lightly he skips over Philadelphia, but then probably he believes the Quaker city has no saloons. "Without warning," according to Mr. Burton, the Irish-American pirates

"bombarded Belfast," using shells filled with Greek fire, and sleeping women and helpless children were blown to pieces in their beds or burned to death before they could escape. Thus in that generous and delicate mode of thought and expression for which English writers are renowned, when dealing with the deeds of other nations, Mr. Burton narrates the destruction of Belfast. It is really surprising that in this day of newspapers and cables any reputable publisher could be found to put such blatherskite between covers—probably the author guaranteed expenses. The price of this remarkable work is 2s 6d, but we do not predict for it an extensive sale here.

Beeson's Marine Directory for 1898, just published, makes the eleventh annual edition of this useful work. The new volume contains a number of pages more than the previous issue, in which the following matters, among others, are classified: List of American Steam and Sailing Vessels on the Lakes, giving chief characteristics; Record of Engines and Boilers of Lake Vessels; List of Vessel Owners; Pilot Rules; Minute Descriptions of American Lake Ports, alphabetically arranged; Classified Directory of Manufacturers and Dealers, besides much data of a nautical, commercial, and legal character. Typographically the book is an excellent production, and the pages are enlivened by many very interesting engravings. Harvey C. Beeson, 308 Royal Insurance Building, Chicago, Ill., is the proprietor and publisher, and the cost of the work is $5.00.

TRADE PUBLICATIONS.

The catalogue received from the New Haven Mfg. Co., New Haven, Conn., illustrates a line of lathes, planers, shapers and a good many other tools such as are used in shipyards and other engineering establishments. The catalogue comprises several pages and is very fully illustrated, the pages being 6 in. by 9 in. in size.

A catalogue and price list of screw-cutting and other labor-saving tools is received from Wells Bros. & Co., Greenfield, Mass. The catalogue is compact in size and fully illustrated, describing a large line of cutters, screw plates, lathes, drills, and other devices of much value for use in machine shops, on board ship, or in shipyards.

A very attractive catalogue is issued by the L. S. Starrett Co., Athol, Mass., illustrative and descriptive of the fine mechanical tools and milling and other cutters manufactured by this company. It comprises over 100 pages and is very fully illustrated. Every user of fine tools would find one of these catalogues valuable for reference.

An illustrated catalogue and price list of high pressure valves and fittings, indicator devices, etc., has been issued by the Kennedy Valve Mfg. Co., 75 John street, New York. It is 7 in. by 10 in. in size, and contains 32 pages of matter well illustrated and neatly printed on coated paper. The index adds much to the value of the catalogue, as do also tables and dimensions and other valuable matter. Copies can be had upon application by mentioning Marine Engineering.

"Can I Become an Electrical Engineer?" is the title of a 64-page pamphlet 5 in. by 7 in. in size issued by the Electrical Engineer Institute of Correspondence Instruction, 120 Liberty street, New York. It is well printed and contains a good deal of information regarding the school which publishes it. It also contains excellent portraits of all leading electricians from the very earliest to the very latest. Any of our readers who have any desire to inform themselves on the subject of electricity should send for a copy of this book, referring to this notice.

Users of paint should have the sheet of sample colors issued by the U. S. Gutta Percha Paint Co., Providence, R. I. This paint is especially adapted for marine purposes as it is elastic and waterproof and is not affected by salt water.

A house organ called "Supplies" is issued by E. F. Houghton & Co., 240-250 West Somerset street, Philadelphia, Pa. It is devoted to the interests of the buyer and user of engine supplies and probably sample copies will be sent to any of our readers who wish them.

People interested in shallow draught boats should send to the Marine Iron Works, Station A, Chicago, for a picture of the "Fortune Hunter," which has just been built by this company for use in Alaska. Full information can be had upon application to the company.

A card is received from the William Powell Co., Cincinnati, Ohio, printed in four colors and illustrating the Powell Star Re-Grinding Valve. The card is 12 in. by 16 in. in size and is prepared for hanging up. In the center is a large picture of a valve printed in color to imitate the brass of which it is made.

Economy Drilling Compound, a lubricant designed especially for use on machine tools and elsewhere, is fully described in a catalogue just issued by the manufacturer, the White & Bagley Co., Worcester, Mass. The pamphlet contains an amount of information and a number of testimonials from users of this lubricant.

A valuable little book of 36 pages giving much information regarding the subject of patents has been issued by the Power Publishing Co., World Building, New York. Every person interested in patents or intending to take out one, whether in this country or in any other, should send for a copy in order to learn all about patents.

An unusually well printed little book 4 in. by 7 in. in size is received from De Grauw, Aymar & Co., 34 and 35 South street, New York, regarding the flags manufactured and sold by this company. The book is printed in several colors on tinted pages and gives a good many samples of flags, ensigns and a variety of colors manufactured by this company; also reproduction in color of the flags of the several nations.

A new catalogue has been issued by the Draper Machine Tool Co., Worcester, Mass. This company makes a specialty of screw-cutting and other lathes, planers, etc. This is a line of tools particularly adapted for use in shipyards, and also in machine shops on board large steamers. The catalogue is well printed, comprising over 50 pages 6 in. by 9 in. in size. It is bound in a neat cover of green with gold lettering.

Hub ball and roller bearings manufactured by the Ball Bearing Co., Watson street, Boston, Mass., are very well described in a 4 1-2 in. by 6 in. catalogue of 36 pages just received. Various types of bearing are fully illustrated and complete price lists are given. The "final word" in the catalogue should be noted by every reader who sends for a copy of this catalogue, and everybody who is interested in the subject of anti-friction bearings will want a copy.

The Van Norman "Duplex" milling machine manufactured by the Waltham Watch Tool Co., Springfield, Mass., is very fully illustrated and described in an eight-page folder just received. This machine has many important features. Among others the cutter head can be set in almost any position or at any angle, giving a very wide range of work. The smallest size machine could readily be used on board steam vessels, while any size would be a most useful tool in a machine shop.

The 1898 catalogue of L. W. Ferdinand & Co., 184 Federal street, Boston, Mass., is very complete as it contains 250 pages 6 in. by 9 in. in size. A string is attached for the purpose of convenience of hanging up. Almost everything that can be of any use to the builder and user of a boat or vessel is fully illustrated and described in these pages. Every one of our readers who has any need whatever for purchasing marine supplies can have a copy of this catalogue by mentioning Marine Engineering.

Graphite Lubrication

There is no substance known so smooth or so enduring as **Dixon's Pure Flake Graphite.** It is the best solid natural lubricant ever discovered. It is not affected by heat or cold, acids or alkalies. It is absolutely indispensable to every marine, stationary or locomotive engineer.

Largely increases the lubricating value of all oils or greases.

Will cool bearings and stop "groaning" or squeaking when all other lubricants fail.

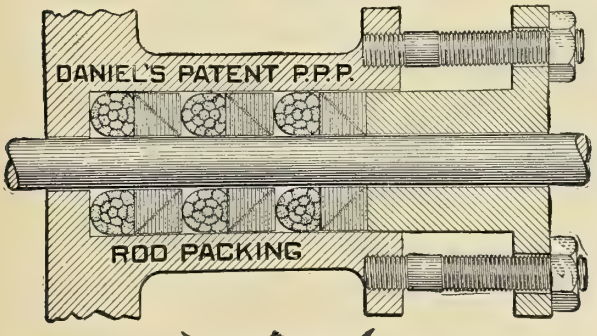
It will pay you to send for Sample and Pamphlet. No charge.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N.J.

Daniel's Patent P. P. P. Diagonal ROD PACKING

BRANCH OFFICES:
PITTSBURG, 105 Water St. CHICAGO, 4 S. Canal St.
SAN FRANCISCO, 514 Mission St. TOLEDO, 638 Leonard St.

The Most Elastic Packing. The Cheapest Packing. Less Friction on the Rod than any other. Wears the longest and gives the least trouble and the greatest satisfaction.



SEND FOR BOOKLET.

Have you seen Daniel's Patent Packing Gauge for Measuring and Cutting accurately Rod Packing, and given away?

Manufactured ONLY by...

C. A. DANIEL, 409 Market Street, PHILADELPHIA, PA.

BUSINESS NOTES.

A HANDSOME 40 FT. LAUNCH.—A handsome launch called the "Samoset," 40 ft. long and costing about $4,000, has just been put into service between the Battery and Ellis Island in New York Harbor. It was built by the Marine Vapor Engine Co., Jersey City, N. J., and has Alco-Vapor engines.

PAINT AND VARNISH REMOVER.—A new material is being put on the market by the Wilson Co., 11 Broadway, New York, which will be of much interest to marine people. It is a preparation which can be applied to a painted surface with a brush and which will remove all the paint or varnish to which it is applied.

ENGINE ROOM OUTFITS.—Two of the new Government torpedo boats building on the Pacific coast will have complete engine room outfits, supplied by the American Steam Gauge Co., 36 Chardon street, Boston, Mass. These outfits include gauges, valves, clocks, etc. The two boats are being built by Wolff & Zwicker, Portland, Ore.

VULCAN WRENCHES.—The wrenches advertised elsewhere by J. H. Williams & Co., 9-31 Richards street, Brooklyn, N. Y., are now being extensively used on a large number of merchant vessels as well as on many naval vessels. The name "Vulcan" as applied to this particular tool is a trademark which has been registered in the United States and in several European countries. Circulars regarding these wrenches are sent to all inquirers.

GARLOCK PACKINGS AND GASKETS.—The piston packings, gaskets, etc., manufactured by the Garlock Packing Co., Palmyra, N. Y., have always been known for their quality and excellence and are fortunate in having had a reputation for the past 18 years. This company has offices and agencies in several parts of the country, as shown by their advertisement, and sends all inquirers catalogues and other information regarding its goods.

EXPERIENCE 40 YEARS

MANUFACTURING

HAND POWER PUMPS— FREE AND FORCE. Yachts, Schooners, Ships, Barges, Scows (Deck and Bilge), Contractors' Trenches, Vaults, Cesspools, Manholes, Brick Yards, Mines, Irrigating, Tanneries, Weir Pole Driving, or for any duty where **Hand Power** is used.

WINCHES. Cargo, Chandelier, Derrick, Portable and Centerboard.

WINDLASSES. Gypsy and Pump Brake.

STEERING GEARS. Cape Catboats, Knockabouts, Sloops, Schooners, Ships, Launches and Steamboats.

RELIEF STEERING GEARS. Steam Yachts, Steamships.

CAPSTANS. Common and Power.

FANCY WOOD STEERING WHEELS. 19 inch to 72 inch.

BRASS WORK. Stanchions, Deck Plates and Gratings, Hood Ventilators.

MECHANICAL FOG HORNS. King (Lever), Edson (Crank).

Street Sweeping Machines. Automatic Bottle Fillers.

Send for Illustrated Catalogue.

EDSON MANUFACTURING CO.,

132 Commercial St., BOSTON, MASS.

ENGINEERS' SUPPLIES.—A hanger lithographed in colors is issued by Patterson, Gottfried & Hunter, 146-150 Centre street, New York, representing a man talking to an engineer. According to the text he is telling of the excellent quality of the supplies furnished by this firm.

THE AMERICAN STOKER.—Users of stokers will be interested in a catalogue issued by the American Stoker Co., Broadway and Liberty street, New York. This stoker works on the underfeed principle and is believed to be well adapted to marine work. We understand that some tests are about to be made to find the efficiency of this stoker on board ship. For stationary work it has already made a reputation.

"HOLDING ITS STEAM."—The recent test of steamer Clara attracted much attention among the guests on the trial trip because of the manner in which the boiler held its steam uniformly in a very rough sea. The boat rolled badly in the lower New York bay, but the water did not leave the gauge glass nor did the boiler siphon when the whistle was blown. No difficulty was encountered in getting under way for want of steam after a stop and although the boat bucked a strong tide for hours plenty of steam was always to be had. The boiler was a "Boyer" manufactured by the Boyer Patent Sectional Water Tube Boiler Co., 90 Wall street, New York.

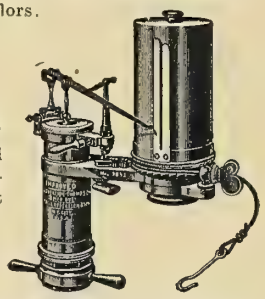
RUBBER AND ASBESTOS PACKING.—Following is a sample order received by A. W. Chesterton & Co., Boston, Mass., for their "Rubberbestos" sheet packing: "Messrs. A. W. Chesterton & Co.—Gentlemen—Please send me five yards 1-16 in. "Rubberbestos." I find this the best sheet packing for general use that I have ever used, and the only one that will stay in our steam traps for any length of time. Yours truly, W. H. Matteson, Chief Engineer, Homeopathic Hospital, Boston." From the success they are having with this new sheet packing it would seem that asbestos and rubber compounded in the manner it is used in "Rubberbestos" is a success.

SEND 2 LABELS

cut from front of boxes of EUREKA PACKING and we will send you a pack of beautiful playing cards. All being special in 3 colors.

MARINE ENGINEERS

should own an INDICATOR and know how to use it. Send for circular and *special* prices. It will interest you.



Jas. L. Robertson & Son,
218 Fulton St., N. Y.

REDUCING VALVES

to control or reduce steam, water or air pressures.

"MASON"

Valves have had a world-wide reputation for years.

Write for prices.

THE MASON REGULATOR CO.,
BOSTON, MASS.

THE YANKEE DRILL GRINDER,

For Grinding Both Twist and Flat Drills,

IS A MACHINE SHOP NECESSITY.

"Can't Grind Wrong."

This machine grinds all sized drills from ⅛ to 2¼ inches. Can be set for any size in a few seconds. Gives any desired clearance. Also grinds 3 lipped drills and chucking reamers.

We know we have the best and latest machine of the kind made.

WE GUARANTEE IT FULLY.

(Copy.)

G. T. EAMES CO., Kalamazoo, Mich. DODGE MANUFACTURING CO, Mishawaka, Ind., May 27th, 1898.

Gentlemen:—We have been intending for some time to write you in regard to the three Twist Drill Grinders which we purchased of you, and trust you will pardon the delay.

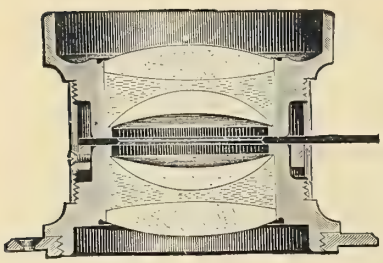
We are greatly pleased with these machines, and find them to be all and even more than your salesman represented. We find them very efficient for the purpose, and superior in many respects to machines which are sold for many times the price of yours upon the market. We are at a loss to know how we ever got along without them, and certainly wish you success in placing them before the trade ofthe country.

Yours truly,
DODGE MANUFACTURING CO., per M. W. MIX, Pres't.

SEND FOR PARTICULARS AND TESTIMONIALS OF USERS.

G. T. EAMES CO., 200 Michigan Avenue, Kalamazoo, Mich.

GOERZ DOUBLE ANASTIGMATIC LENSES



Cover sharply up to the circle of light, have great depth of focus and unequalled speed, and are therefore the only lenses which will satisfactorily photograph engine room interiors.

CATALOGUE FREE ON APPLICATION.

C. P. GOERZ,

52 Union Square, East, = = = = = = *New York,*

AND AT ALL DEALERS.

THE EMPIRE MARINE MOTOR.—The manufacturers of these motors, C. C. Riotte & Co., 1955 Park Ave., New York, have been rushed with orders this spring to supply the demand. They are made in sizes from one to twenty horse power and have several distinctive features, which are described in a circular issued by the company regarding them. This company also supplies launches and many auxiliary appliances.

NICKEL STEEL FOR BOILERS.—Every engineer will be interested in some tests of nickel steel which have been made by the Orford Copper Co., 37 Wall street, New York. Regarding three boilers built a recent letter from the company states: "When the first boiler was built, we could not convince the builders that it would be wise or safe to reduce the thickness of the steel, so it was built of the same weight as ordinary boilers. We then had two more built, and here the thickness of the shell was reduced about 1-8 in. We were unable to get tubes of nickel steel, so that in all three boilers the tubes were of ordinary steel. One boiler has now been built for nearly two years; the last two have been running since last November. After running a time the interior of the nickel steel boilers becomes perfectly smooth and almost glassy, therein differing, for some reason which we cannot explain, from ordinary boilers. We find there is a considerable saving of fuel in these boilers as compared with ordinary boilers working immediately alongside under exactly the same conditions. We are now having another boiler constructed with nickel steel tubes, which are to be made by the Shelby Tube Co., of Cleveland, Ohio."

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

A 75 FOOT STEAM YACHT FOR SALE.

A fine steam yacht 75 ft. long, 12 ft. 6 in. beam, equipped with Wells quadruple engines and water-tube boilers, surface condensers, circulating pumps, speed 18 miles an hour, is offered for sale. Is in prime condition in every respect and has carrying capacity of 75 passengers. For particulars address Steam Yacht, care Marine Engineering.

PROFESSIONAL CARD.

H. B. ROELKER,

CONSULTING AND CONSTRUCTING ENGINEER.

Manufacturer of **Screw Propellers** for Usual and for Special Work.

The Allen Dense Air Ice Machine for Steam Vessels.

41 MAIDEN LANE, NEW YORK.

PORTABLE FORGES.—The portable forges offered by the Crumlish Forge Co., 80 Virginia St., Buffalo, N. Y., are being much used not only in shipyards, but on board many vessels, because of the many valuable features. They are constructed of steel, weigh only 90 lbs., and occupy only 19 in. of deck space. Sheet steel bellows are an important feature. Many very complimentary testimonials are printed in a folder, which will be sent by the company to all who are interested in the subject.

PASTE, FOR ENGINEERS. NO ACID. NO GRIT. LIQUID, FOR YACHT BRASS, &c.

Only polish that will clean burnt oil and rust from iron and steel.

Polishes all metals.

STAR METAL POLISH.

Gives high polish to brass, nickel, &c., with very little labor.

The best for yachts, &c.

For Samples, &c., address **J. P. COLE, 80 Cortlandt St., N. Y.**

The Mabbs Hydraulic Packing.

USED ON FASTEST ATLANTIC LINERS.

This packing has no equal for Propellers, Stern Pipes, Water Works, Deep Mine Pumps, Ice Machines and all machinery using cold water.

It is the most pliable and durable Hydraulic Packing in the market. *It can be worn entirely out, simply by adding new packing when required, and not disturbing the old.* It will never cut a rod or cylinder, on account of the nature of the material, it being always a good lubricant in itself.

MABBS HYDRAULIC PACKING COMPANY,

BOX 829, CHICAGO.

Telegraphic Address: Mabbs, Board of Trade Bldg.

IMPERIAL METAL POLISH.

IMPERIAL
METAL
POLISH.
EASILY APPLIED.
RADIANT IN LUSTRE.
INSTANTANEOUS IN ACTION.
ALL METALS, HOT OR COLD.
LIQUID OR PASTE.

MADE BY

THE RATH MANUFACTURING CO.

New York—Philadelphia.

18 and 20 Liberty Street, NEW YORK CITY.

Hancock, Laurel & Second Sts., PHILA., PA.

NEW YORK OFFICE:

WILLIAM E. BURTON, Manager.

EXPORT DEP'T.

FREDERICK W. KRISTELLER.

Remember the name IMPERIAL.

W. P. PHILLIPS & CO.,

MANUFACTURERS OF

OIL CUPS,
LUBRICATORS,
GREASE CUPS

—AND—

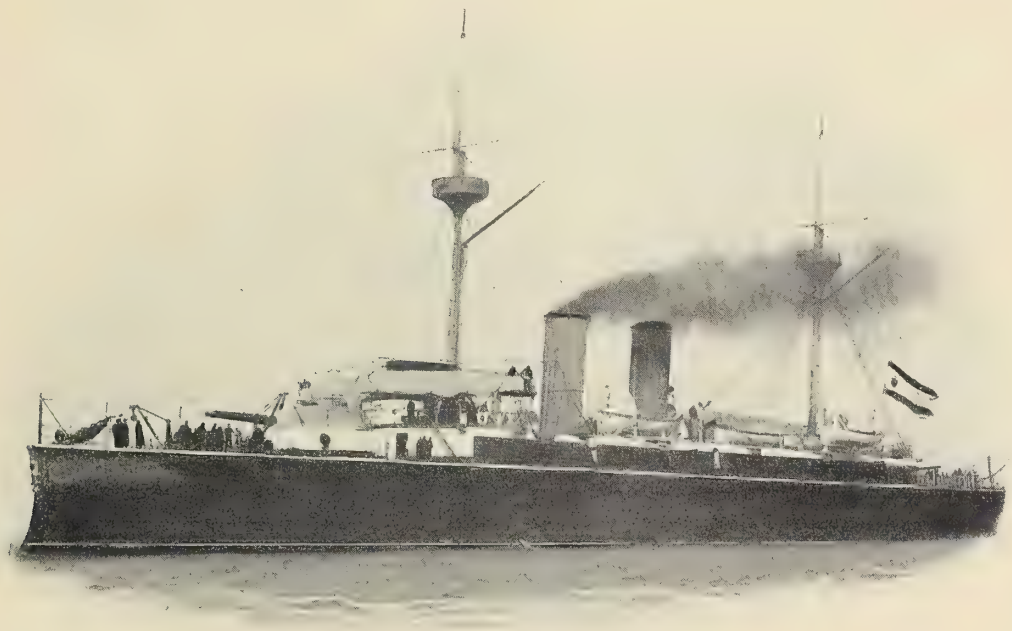
ENGINEERS' SPECIALTIES,

No. 71 Sudbury St., BOSTON, MASS.

Vessels of the Spanish Navy Sunk or Captured by the American Blockading Squadron in the Sea Fight off Santiago, Cuba, July 3, 1898.

ARMORED CRUISER INFANTA MARIA TERESA, FLAGSHIP OF ADMIRAL CERVERA.

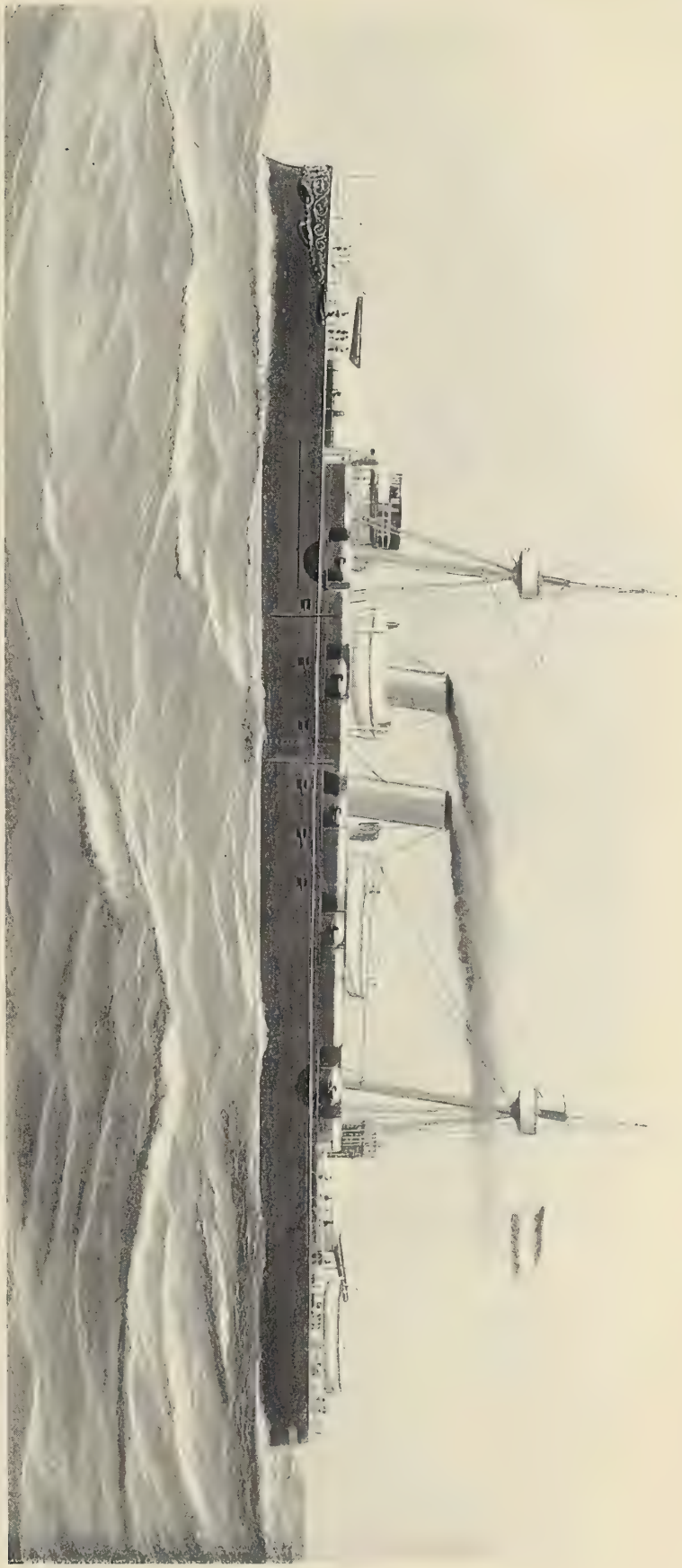
Photograph copyrighted by Johnson, N. Y.



ARMORED CRUISER VIZCAYA, AS SHE APPEARED RECENTLY IN NEW YORK HARBOR.

Photograph copyrighted by Johnson, N. Y.

FOR DESCRIPTION SEE PAGE 9.

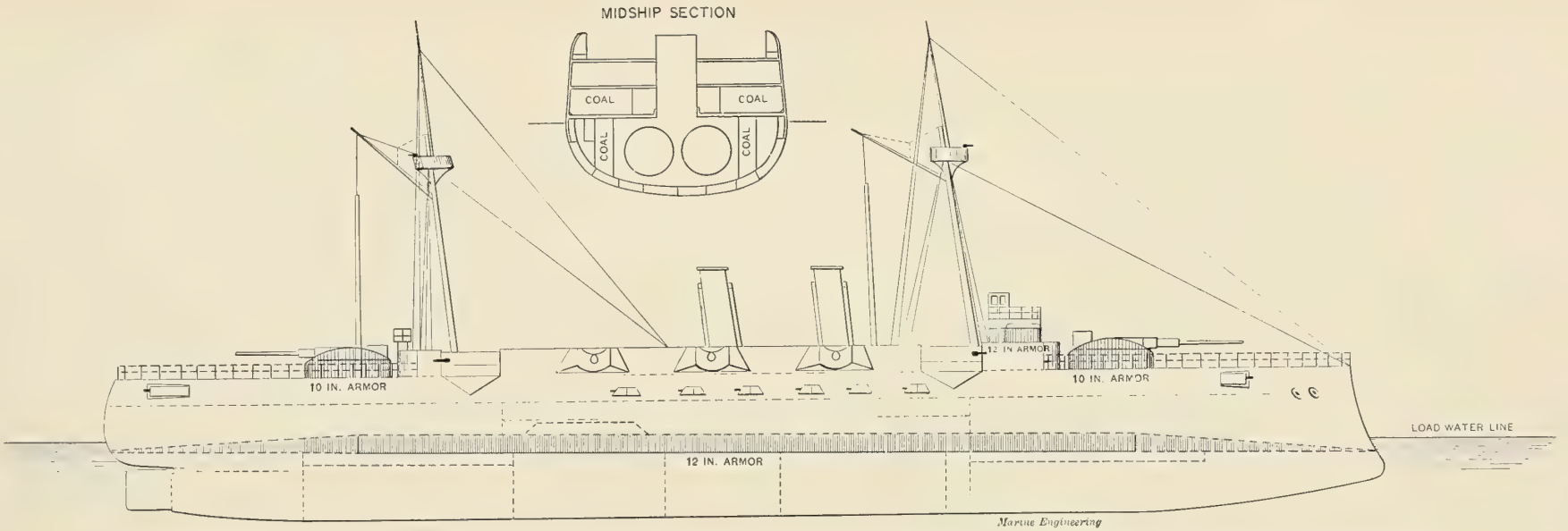


ARMORED CRUISER ALMIRANTE OQUENDO, WHICH, WITH THE VIZCAYA AND INFANTA MARIA TERESA, WAS BUILT AT BILBAO, SPAIN.

FOR DESCRIPTION SEE PAGE 9.

ARMORED BARBETTE CRUISER CRISTOBAL COLON, ORIGINALLY THE GARIBALDI, BUILT IN ITALY FOR THE ITALIAN NAVY.

FOR DESCRIPTION SEE PAGE 9.



DISPOSITION OF HEAVY ARMOR ON THE SPANISH CRUISERS ALMIRANTE OQUENDO, VIZCAYA AND INFANTA MARIA TERESA.

TORPEDO-BOAT DESTROYERS PLUTON AND FUROR, BUILT AT CLYDEBANK, SCOTLAND, FOR THE SPANISH GOVERNMENT.

FOR DESCRIPTION SEE PAGE 9.